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The Automobile

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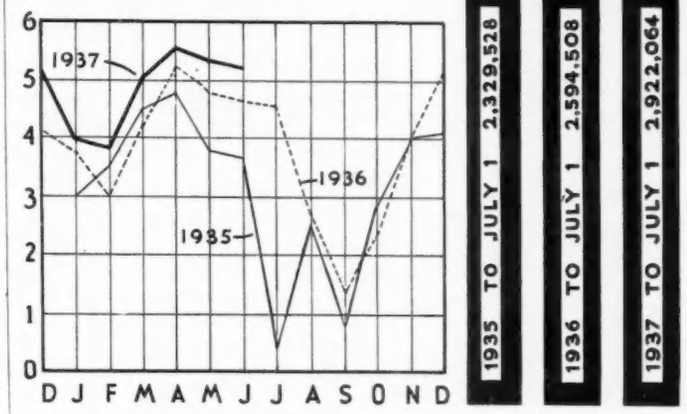
AUTOMOTIVE PRODUCTION*

Passenger Cars and Trucks —U. S. and Canada

Bar charts at the right represent total production to July 1st of year indicated.

Numbers at left of monthly graph below show production in 100,000's.

*From Department of Commerce Report and Automobile Manufacturers' Ass'n.



An Idea in Zinc

The thinking of motor car engineers is largely guided by consumer preferences—a fact well illustrated by the increasing use of die cast radiator grilles. The quality of solidity inherent in the die cast grille is finding increasing consumer recognition and favor. Today the unmistakable trend is to grilles assembled from two or more die cast sections fitted into a suitable sheet metal frame for easy replacement.

Since it has become almost universal practice to make seasonal changes in grille design, the die casting process has emerged as a technique of great versatility. When compared with a sheet metal stamping the die casting process offers many advantages, not the least of which is the ability to produce parts of varied intricacy depending upon current design trends. Completely new designs can be translated into accurately finished parts without delay.

Another important factor is the ease with which zinc alloy die castings take and hold lustrous bright-plated finishes. Needless to say, the remarkable acceptance of zinc alloy die castings has been intimately associated with the research tested Zamak type alloys based on zinc of 99.99+ per cent purity. Perfectly fitting castings of high structural strength and stability result from the use of these alloys. The New Jersey Zinc Company, 160 Front Street, New York, N. Y.

Idea No. 2

THREE LETTERS
THAT SPELL STEEL

THE letters USS are a symbol of the finest in any type of steel. They are your assurance of a product—first, made in mills with modern equipment and methods—second, made by skilled workmen who take pride in their jobs—and third, backed by research laboratories that are never content with past achievements.

To carry on this tradition, United States Steel is investing more than a hundred million dollars during 1937 in new plants and equipment, employing more men, at higher wages, than ever before in its history. Truly, the world moves forward with Steel.

Published Weekly
Founded 1895

AUTOMOTIVE INDUSTRIES

July 17, 1937
Vol. 77, No. 3

Full Month of '37 Production Ahead

Most Plants Still "Chipping Away at the Order Bank"; Changeover Period to be Held to Minimum

Volume production of a number of 1937 models is expected to run for another month before shutdowns for changeover to the new models. Instead of tapering off gradually during July, several plants will continue to assemble current models at a fairly high rate until about the middle of August when they will stop rather abruptly. Those companies which were not seriously affected by strikes last spring, are tapering off now, however, and some are about through with 1937 runs.

By no means will all departments of all plants be down completely during the latter part of August and early September. This year, because of labor troubles, production arrangements have been irregular. Some departments were operated while final assembly lines were strike paralyzed and consequently built up inventories of finished parts. They will stop 1937 runs before those which were closed by strikes, and will be working on 1938 lines long before car production really gets under way.

Short plant closures for changeover will be the general rule. So far as can be seen now, model changes will not be so extensive as to result in long preparatory periods before the 1938 cars can be assembled. In some cases, new machinery is now being bought for the ultimate purpose of adding to 1938 production capacity. Probabilities are that it will be used initially to speed new cars into the hands of dealers for first showings. These will begin to come along in October just before the national show, scheduled for Oct. 17 in New York.

Labor troubles for the time being have faded more or less into the background and some plants are hopeful of being able to get through the balance of the year without further stoppages. Plant disputes are being settled largely without sitdown strikes, it is said. At the moment, the only thing that is hampering assemblies is the weather. Where men in the hot departments of plants are affected by the present conditions, and the departments are forced to close half days, final assemblies are slowed up subsequently for lack of materials.

Current state of the market is indicated in the comments of several manufacturers who state that they will come very close to original 1937 production schedules. "Still chipping away at the order bank" is the comment that seems to typify many operations. One manufacturer of moderate priced cars reports that the schedule calls for 40,000 still to be built. Another large manufacturer of a low-priced line re-

(Turn to page 79, please)

This Week

NEWS brings some comments by CIO's Adolph Germer to AUTOMOTIVE INDUSTRIES . . . a review of an active week for aviation . . . highlights on Washington, Pa., session of 1000 Pennsylvania automobile dealers . . . details on new sleeper coach . . . story on Ford test of the Wagner Act.

FEATURES emphasize light metal alloys in article No. 5 of the Materials Series . . . an improved oil filter is fully described . . . data on new tractor engine for Minneapolis-Moline tractor . . . sectional drawings of the same engine are reproduced . . . a method for calculating mixture ratios for maximum power and economy is fully explained.

UAW Quiets Followers

Endeavoring to Reinforce Public Support and Win GM Contract Which Depends on Membership Control

United Automobile Workers headquarters, in Detroit, report matters comparatively quiet. It is the opinion that sporadic troubles at plants are being settled more easily than before. Some factory men feel that the union management is trying its best to keep things running smoothly for two reasons. One is to win back public support, and the other to meet the condition laid down by General Motors, that new contract negotiations must depend on assurance of control of members by the union.

There was a short stoppage at the Bohn Aluminum plant late last week. The sitdown of some 600 was settled in about three hours. There still is in progress a strike at Fruehauf.

Henry C. Kahle, president of UAW local No. 62 at Jackson, Mich., who resigned last week, took with him when he withdrew some 90 members of the Jackson Motor Shaft branch. Union headquarters in Detroit reported that the remaining 2500 members of the local, which includes a score of shops in the district, will elect new officers at the end of this week. It was said that Kahle was doing nothing for the union there because of his inactivity.

Adolph Germer, regional director for the CIO, has established offices in Detroit near UAW headquarters. There is little doubt but that he will have something to do with automobile company organization, although his principal duty will be to take off the hands of the UAW the organization of other industries in the area. Mr. Germer told AUTOMOTIVE INDUSTRIES that he has no instructions to take over the handling of the General Motors negotiations, that he expects to have little to do with the automobile industry unless he is asked by UAW officials to sit with them on automotive matters.

GM Negotiations Date Set

Homer Martin, president of the United Automobile Workers Union, announced July 15 that new contract negotiations with General Motors would begin the following week. The negotiations will be handled for the Union by a committee of four, including Martin. Other names were not announced. Conferences were arranged on the day of the announcement in telephone conversations with Floyd O. Tanner, GM's labor-relations director.

Penna. Dealers Face 'Morning After'

Enthusiasm for Licensing Bill Wanes When vanDerZee Gives It a "Going Over"

Flocking to Washington, Pa., in unprecedented numbers, one thousand Pennsylvania automobile dealers attended their annual convention on July 12 and 13 to learn particulars of the used car price-fixing and licensing bill that will become operative in the state as soon as the Governor appoints a commission of five men to administer it.

Highlight of the meeting was the waning of dealer enthusiasm for the licensing bill after a straightforward talk by A. vanDerZee, Dodge sales chief, who pointed out that some of the methods now being proposed for dealing with problems in the retail automobile business are of far greater import and danger than the problems themselves could ever be, even if left alone, and that the threatened cures may very easily be more poisonous than the diseases.

Mr. vanDerZee said, in part: "If we will face all of our problems as such, set our objectives, and approach these objectives in the light of past experience and in the light of the tremendous accomplishments of the automobile industry thus far, economically and socially, we will, I am confident, discover the sane and practical solutions.

"If, on the contrary, we approach our objectives without weighing carefully the obligations of the measures we are taking, we are likely to throw out the baby with the bath water, and new and more difficult complications will be the result."

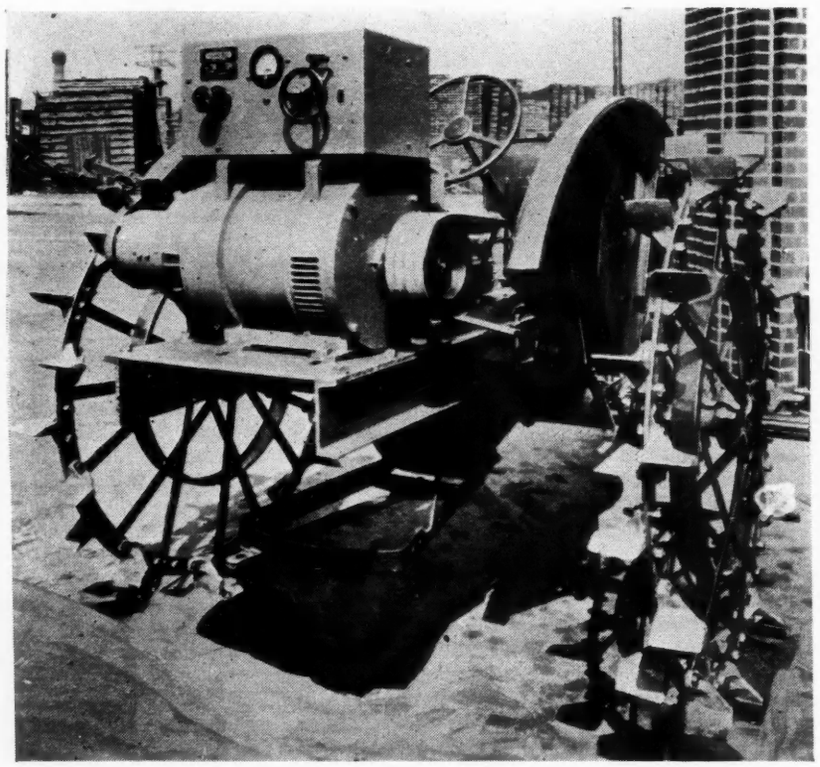
Although it has been indicated that the Pennsylvania Automotive Association endorsed the price-fixing bill, several members of the board of directors were outspoken in their comments as to its impracticability and unconstitutionality. One director, and former president of the association, stated that a majority of the board had been opposed to the legislation from its inception but that they had been "horsed" into endorsing it by a militant group of dealers from the Pittsburgh area.

From Philadelphia came word that an Independent Automobile Dealers Association had been formed to oppose the "little NRA" on the basis that it will drive buyers of new and used cars to other states.

About 80 member of the organization met July 8 to lay plans to fight the act. They object to the bill on the ground that it is class legislation aimed at automobile dealers. They charge that the bill deprives the public of the right of contract, and that the Legislature has no right to fix the price of a commodity which is not affected by public interest. The association maintains that there are two paths open in the fight against the bill. It can seek an injunction in court to prevent the Governor from naming the commission —consisting of one exclusive used car dealer, two new car dealers, one new car salesman, and one individual not interested in the business of retailing motor vehicles—or the group can attack the constitutionality of the law.

It was evident at the Washington meeting that many of the larger dealers had come to realize the seriousness of the legislation—placing as it does a premium on mediocrity—while, for the most part, the smaller operators look forward to a protection of capital and increased profits.

R. H. Grant, vice-president of General Motors, also spoke at the meeting, but avoided speculating as to the effects of the legislation. In the main, his talk was confined to pointing out what GM is doing to alleviate dealer problems caused by too many dealers in an area as compared with the potential for business, production of too many new cars, dissatisfaction with the cancellation clause in the contract, cross selling, and over-bidding on used cars.—E. C.



NEW USE of a farm tractor was demonstrated recently when the Southern California Tractor Co., Los Angeles, fitted an arc welding generator to a regulation size tractor. The generator is a standard model, 200 ampere unit, manufactured by Lincoln Electric Co.

Tire Industry Trims

Further Retrenchment in August Seen Unless Buying Spurts

With inventories still abnormally high, dealer stocks heavy, and replacement sales far below expectations, tire manufacturers have started their seasonal trimming of production schedules with almost positive indications of further drastic retrenchment in August unless there should be a sudden spurt in consumer buying. In Akron the curtailment has been materially accentuated by the extent to which major Akron manufacturers have decentralized.

Goodrich has ordered 1000 employes laid off and an additional 500 furloughed for the remainder of the summer. The probability that the 1000 laid off will not be recalled to work in Akron is seen by tire industry observers. Goodrich now has a branch tire plant at Oaks, Pa., producing 6000 tires per day. It is planning a new mechanical rubber goods plant in Cadillac, Mich., and has substantially increased production in its California factory.

Goodyear will close most of its Akron factories July 19 for mass vacations of all employes entitled to vacations with pay. This will mean that the Akron plant will operate with only a skeleton force until Aug. 1—about 65 per cent of Goodyear's Akron employes will get paid vacations. Those with service records of from 5 to 10 years getting one week each and all with service records of 10 years or more getting two weeks each. Goodyear is operating heavily in

its Gadsden, Ala., Cumberland, Md., and Los Angeles tire factories. It is producing upward of 6000 tires per day in its new factory in Jackson, Mich., and it is reported that the Jackson plant will become the key Goodyear factory with a capacity before the end of this year of 18,000 tires per day.

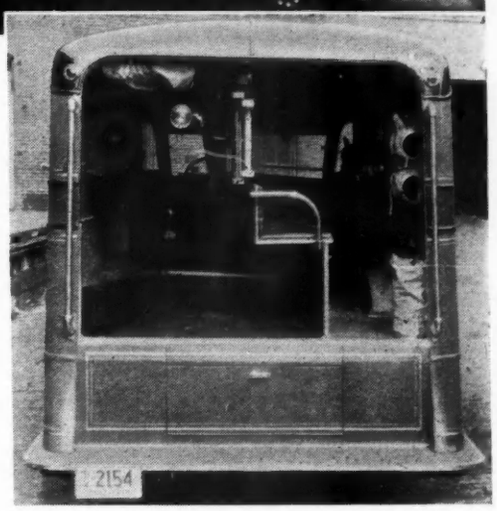
Firestone has never returned to a full production schedule since the end of its two months' strike and fully 1000 Firestone employes were never recalled after the strike while those who were recalled are operating on reduced hours. Firestone is reported to be heavily increasing the installation of tire-building machinery in its recently acquired plant in Memphis, Tenn., and has heavily increased production in California. It recently bought land at Riverview, Mich., for a large wheel and rim and steel products plant.

The dollar picture of sales is, of course, vastly improver over a year ago. Revenues being nearly 15 per cent greater. In the last half year the four major manufacturers will benefit by the recent 10 to 15 per cent increase in original equipment prices.

Crude rubber prices are expected to show further declines as result of two important developments:

(1) The current program of recession in tire production and consequently in rubber consumption.

(2) The rush of shippers from Singapore to get as much rubber to the United States as possible before the new $15-a-ton marine freight rates become effective Aug. 1. This will be an increase of about $2.50 per ton. Crude rubber prices reached a 10-year high last March of over 27c. per pound. It now appears almost certain that crude prices will find a fair level of between 17c. and 18c. a pound.



EVERYTHING INSIDE is the rule on the 1000-gallon pumpers like this, of which four have been delivered to the City of Detroit fire department. Built by the Seagrave Corp., Columbus, Ohio, the all-enclosed apparatus has been demonstrated to fire-fighting officials in many communities and has been freely designated as the fire apparatus of the future. Power is supplied by a 12-cyl., 45-deg. vee engine of 240 hp., said to be the most powerful used in fire apparatus. Seagrave aerial ladders are now being supplied with tractors mounting a safety cab which seats 8 men, has a steel top and safety glass.

Ford to Attack Wagner Act

Plans New Court Test on Grounds Not Covered in Recent Decisions; Finds Act Bar to Free Speech

The Ford Motor Co. has already determined that it will test the Wagner Act and is prepared to take its case to the Supreme Court as quickly as may be possible. Portions and implications of the act not covered in the recent court decision upholding it will be the basis for the action.

Strategy of the motor company in its defense against charges brought by the CIO, now being heard in Detroit by a special National Labor Relations Board inquiry, is to interpose only routine legal objections to the evidence on the circumstances of the fight between company men and union organizers at the gates of the company's Rouge plant May 26. The company is convinced that it will be made to "look bad" so far as that part of the case is concerned.

Charges that the company has attempted to influence employes against the union through anti-union utterances by Henry Ford will be fought to the end, it is indicated. The company will take the position that the Wagner Act is in effect a bar to free speech, if under the act, the NLRB seeks to prevent Mr. Ford from giving voice to his opinions. There is a constitutional guarantee of free speech, and this the company will defend up to the Supreme Court.

Charges that the company discharged employes for union activities will also be fought with the full resources of the company. It will, at the later phases of the Detroit hearings, introduce as witnesses plant foremen, who will testify that the men were discharged for inefficiency. The company

(Turn to page 80, please)

Truck Sales For May Best on Record

New Truck Registrations

	May 1937	April 1937	May 1936	Five Months 1937	Five Months 1936	Per Cent Change, 5 Months 1937 over 1936	Per Cent of Total Five Months 1937	Per Cent of Total Five Months 1936
Ford	20,452	22,897	17,971	97,192	79,464	+ 22.3	34.29	30.14
Chevrolet	20,772	22,709	21,443	82,946	94,379	− 12.2	29.26	35.80
International	7,279	6,894	6,704	31,493	28,515	+ 10.5	11.11	10.82
Dodge	6,045	4,090	8,507	25,440	35,838	− 29.0	8.97	13.59
G. M. C.	4,536	4,815	3,045	19,423	8,515	+126.0	6.85	3.23
Plymouth	1,506	1,203	285	4,779	1,190	+300.0	1.69	.45
Diamond T	867	916	754	4,097	3,177	+ 29.0	1.44	1.21
White	684	662	541	2,758	2,167	+ 27.1	.97	.82
Mack	588	594	440	2,415	1,110	+117.0	.85	.42
Studebaker	720	725	358	2,314	1,183	+ 95.0	.82	.45
Terraplane	509	516	240	2,218	753	+194.0	.78	.29
Reo	424	394	399	1,984	1,598	+ 24.2	.70	.61
Federal	301	258	275	1,213	1,144	+ 6.0	.43	.43
Autocar	198	228	109	847	450	+ 88.0	.30	.17
Brockway	183	184	168	724	656	+ 10.2	.26	.25
Indiana	111	157	178	653	630	+ 3.7	.23	.24
Stewart	120	121	116	583	448	+ 30.0	.21	.17
Divco	183	116	141	556	455	+ 22.1	.20	.17
Willys-Overland	77	107	235	442	903	− 51.0	.16	.34
Stutz Pack-Age-Car	60	39	....	256	....	....	.09	....
F. W. D.	70	34	35	226	170	+ 33.0	.08	.06
Sterling	28	47	16	153	66	+132.0	.05	.03
Kenworth	10	9	....	58	....	....	.02	....
Schacht	4	8	....	32	....	....	.01	....
Miscellaneous	130	161	223	654	817	− 20.0	.23	.31
Total	65,857	67,884	62,183	283,456	263,628	+ 7.4	100.00	100.00

Big Week for Aviation

Marked by Atlantic Survey Flights and Millionth Mile on Pacific

Latter stages of the two-week-old search for Amelia Earhart and Fred Noonan, sent Navy planes into the air for one of the most intensive "business" flights in the history of the Navy and saddened the fringes of an otherwise jubilant week for aviation.

The Atlantic and Pacific Oceans were criss-crossed last week in flights which go far to complete the girdling of world maps by the fine lines indicating operation of commercial airways. Landing in Manila, July 12, the *Philippine Clipper*, on behalf of her three sister ships *(China Clipper, Hawaiian Clipper, Hong Kong Clipper)* marked the millionth mile of commercial operation on the 8500-mile airlane between San Francisco and Manila, and the 500-mile "ferry lane" between Manila and Hong Kong shuttled by the flying boat named for the Chinese city.

At the Port Washington (L. I.) seaplane terminal on July 10 the Pan American's inbound *Bermuda Clipper* saluted Imperial Airway's flying boat *Caledonia* fresh from its survey flight from Southampton, England, poised for the return flight of 1994 miles to Foynes, Ireland. Meanwhile at Hamilton, Bermuda, Imperial Airway's *Cavalier*, counterpart of the *Caledonia*, refueled to take its place in the P.A.-Imperial joint schedule between New York and Bermuda.

Before the end of the week, Pan American's *Clipper III* and the *Caledonia* were respectively on their return flights to America and England. The airline distance record which has stood since Aug. 7, 1933, fell with a bang July 14 when Russian pilots Gromov and Yumosheff with navigator Danilin brought their single-engined monoplane down at San Jacinto, Calif., after flying from Moscow across the North Pole for an air line distance of 6262 miles. Their time in the air was 62 hr. 17 min., unofficially. Previous airline distance record was established by Rossi and Codos of France in a flight from New York to Syria.

There are now 7914 licensed and 1766 unlicensed aircraft in the United States, according to the quarterly census of the Bureau of Air Commerce, released July 8 to cover the period to the end of June. Pilots' licensed now total 16,578, of whom 456 are women. Of the pilot's licenses 7308 classify as transport, 882 as limited commercial, 7581 as private and 808 as amateur.

In the previous quarter of the year the total planes licensed stood at 7629 and pilots at 15,865. Each category of planes and pilots shows a substantial increase for the quarter.

Pilots who complete the transcontinental run supplementing the Bendix Trophy race will land at Bendix, N. J. on Sept. 3. Official course of the race is from Los Angeles to the finish line of the National Air Races in Cleveland for a total purse of $25,000. To win the transcontinental bonus the record held by Howard Hughes must be bettered. Great-circle airline distance between Los Angeles and Bendix is 2446 miles.

By the time of the race, work will be well under way on the major portion of the ten buildings planned for the aviation city whose coming to Teterboro resulted in the change of the town's name to Bendix. More than 500 acres of land have been purchased or optioned by Bendix interest, of which, for the present, about 400 will be used for an improved airport.

Buildings devoted to administration, engineering, instruments, electrical and general manufacturing, foundry, heating plant and warehousing will occupy 385,000 sq. ft. where aeronautical activities of the Bendix Aviation Corp. will be centered. Construction of first units is expected to be completed by November.

Bendix, N. J. is now about 30 minutes from midtown Manhattan via the George Washington bridge. With the completion of Manhattan's midtown (38th St.) tunnel it is expected the time will be cut to about 20 min.

PLANES in the news. (Top) Broadside view of *Clipper III*, Pan American's Atlantic survey plane. (Center) Imperial Airways' four-engined *Caledonia* for the Atlantic Crossing, sister ship of the *Cavalier* used on the Bermuda-New York leg. Prof. Otto J. Schmidt, in the lower picture, stands beside one of the planes which landed his Soviet Polar Expedition at the North Pole, where four members of the expedition will remain for a year to collect scientific data.

Wright Gets Engine Order

The Wright Aeronautical Corp. will supply 354 "Cyclone" engines at a cost of about $9000 each to the United States Government for use in the 177 Douglas two-engine bombardment planes just ordered at a further cost of $11,651,948. Engine delivery will begin as soon as the bomber order begins to be delivered.

Splitdorf Offers New Magneto

Permanent-magnet alloy of nickel-cobalt-aluminum is used in the rotors of the new Edison RM magneto developed by the Edison-Splitdorf Corp., West Orange, N. J. Contrary to conventional practice magnets in the RM model rotate within the field coils. Heat value of the spark produced is said to be 50 to 100 per cent greater than in older practice.

Calls Safety Work Failure

Roper's Conference Implies That Cars Are Not as Safe As They Could Be and Comes Out for Governors

Efforts of accident-prevention groups supported by automotive-industry funds to promote careful driving have failed and motor-accident fatalities have mounted steadily since organized safety work was first started by the National Safety Council in 1935. These categorical statements introduce the section on "Traffic Accidents" in a pamphlet titled "Accidents and Opportunity" released by the Accident Prevention Conference of the U. S. Department of Commerce.

"Everyone agrees that speed must be controlled," the pamphlet continues, and "there is an insistent demand for a reliable speed-control or governor."

"Do not be discouraged." says the pamphlet," by the oft-repeated statement that cars today are 'made as safe as human ingenuity can make them.' This statement will not bear analysis."

The Accident Prevention Conference, of which Labert St. Clair is director, exists and functions by Presidential mandate, under Daniel C. Roper, secretary of Commerce. The pamphlet "Accidents and Opportunity" was printed in the Government Printing Office, and is the first direct-publicity effort by the conference.

Text of the introduction of the portion of the pamphlet devoted to "Traffic Accidents" follows:

"Most highway fatalities are due to fast or careless driving. To date, most of the efforts of accident-prevention groups, supported largely by automotive-industry funds, have been directed at inducing drivers to drive carefully. Generally speaking, this plan has failed. Motor-accident fatalities have mounted steadily since organized safety work was first started by the National Safety Council in 1913. Particularly have they increased with the development of the high-speed car which began in about 1925.

"Everybody agrees that speed must be controlled.

"The automotive industry is clinging desperately to the theory that its vast army of salesmen can sell high-speed cars (with emphasis on their power) and then a much smaller group of safety workers can induce owners to drive moderately and carefully. This theory is being rapidly disproved.

"There is an insistent demand for a reliable speed control, or governor. Automotive manufacturers say no governor has been designed which cannot be tampered with. Such a device or some plan which would effectively keep speeds within safe limits would meet a great public demand and should pay its designer well. A far from perfect one, used on 20,000 trucks in

(*Turn to page 79, please*)

U. S. New Car Registrations and Estimated Dollar Volume by Retail Price Classes*

	New Registrations				Estimated Dollar Volume			
	May		First Five Months					
	Units	Per Cent of Total	Units	Per Cent of Total	May	Per Cent of Total	First Five Months	Per Cent of Total
Chevrolet, Ford and Plymouth	226,471	57.83	963,922	58.94	$156,700,000	50.56	$667,000,000	51.65
Others under $750	5,929	1.52	23,086	1.41	3,400,000	1.10	13,150,000	1.02
$750-$1000	137,540	35.12	557,074	34.06	120,300,000	38.82	486,500,000	37.67
$1001-$1500	18,647	4.76	78,602	4.81	22,500,000	7.26	94,700,000	7.33
$1501-$2000	1,459	.37	6,010	.37	2,500,000	.81	10,300,000	.80
$2001-$3000	1,303	.33	5,422	.33	3,400,000	1.10	14,300,000	1.11
$3001 and over	259	.07	1,340	.08	1,100,000	.35	5,450,000	.42
Total	391,608	100.00	1,635,456	100.00	$309,900,000	100.00	$1,291,400,000	100.00
Miscellaneous	89		763					
	391,697		1,636,219					

* All calculations are based on delivered price at Factory of the five-passenger, four door sedan, in conjunction with actual new car registrations of each model. The total dollar volumes are then consolidated by price classes. No comparative data with a year ago are available due to the change in the listing of the prices from the old F.O.B. which did not include certain standard equipment, to the new delivered prices which include standard equipment, Federal taxes but no transportation charges.

Five Months' Total Up 10 P.C.

New Passenger Car Registrations

	MAY 1937	APRIL 1937	MAY 1936	FIVE MONTHS 1937	FIVE MONTHS 1936	Per Cent Change, 5 Months, 1937 over 1936	Per Cent of Total Five Months 1937	Per Cent of Total Five Months 1936	Seven Months 1937 Models	Seven Months 1936 Models	Seven Months Per Cent Change
Ford	94,007	98,502	85,208	407,291	335,245	+ 21.3	24.89	22.60	498,352	446,422	+ 11.3
Chevrolet	83,222	95,114	109,598	341,537	425,294	− 19.6	20.88	28.67	485,190	546,515	− 11.4
Plymouth	49,242	32,260	55,637	215,087	206,001	+ 4.3	13.15	13.89	304,490	268,853	+ 13.0
Dodge	27,183	19,624	27,832	118,360	103,752	+ 14.0	7.23	6.99	160,598	136,628	+ 17.5
Pontiac	24,246	24,776	20,406	93,773	72,312	+ 29.8	5.73	4.87	125,873	94,732	+ 32.8
Oldsmobile	22,308	23,537	23,956	86,305	87,186	− 1.1	5.27	5.88	110,623	114,754	− 3.5
Buick	21,851	23,230	17,950	83,186	65,826	+ 26.2	5.08	4.44	120,871	90,729	+ 33.0
Packard	11,400	12,615	6,302	47,468	23,185	+105.0	2.90	1.56	61,965	31,838	+ 94.2
Chrysler	9,390	7,742	6,603	38,821	24,712	+ 57.0	2.37	1.66	51,142	29,392	+ 74.0
Terraplane	7,694	6,522	9,535	35,914	34,135	+ 2.2	2.20	2.30	49,492	44,134	+ 12.2
Nash	8,725	8,796	5,171	34,080	18,305	+ 86.0	2.08	1.23	42,482	23,579	+ 80.1
Studebaker	7,805	9,315	7,657	33,882	28,277	+ 19.8	2.07	1.90	46,185	34,243	+ 34.9
De Soto	7,825	6,253	4,655	32,076	16,299	+ 96.5	1.96	1.10	41,241	20,058	+106.0
Willys	5,929	5,924	1,309	23,086	4,590	+401.0	1.41	.31	24,768	6,801	+264.0
La Salle	3,309	3,365	1,394	12,714	5,164	+147.0	.78	.35	17,186	7,356	+134.0
Lincoln	2,795	2,996	1,367	11,776	5,283	+123.0	.72	.36	15,540	6,255	+148.0
Hudson	1,599	1,414	2,611	7,381	10,328	− 28.6	.45	.70	10,747	14,496	− 25.6
Graham	1,450	1,643	2,021	6,268	6,655	− 5.7	.38	.45	8,806	8,487	+ 3.9
Cadillac	1,466	1,410	1,209	5,606	5,039	+ 11.2	.35	.34	7,960	7,224	+ 10.2
Cord	135	114	169	561	406	+ 38.0	.03	.03	699	406	+ 72.0
Pierce-Arrow	16	21	71	136	347	− 60.8	.01	.02	236	503	− 53.1
Auburn	11	14	284	133	1,122	− 88.0	.01	.07	268	1,630	− 16.4
Miscellaneous	89	90	1,799	679	4,132	− 83.5	.04	.28	2,284	6,082	− 62.5
Total	391,697	385,277	392,744	1,636,120	1,483,595	+ 10.1	100.00	100.00	2,186,998	1,941,117	+ 12.6
Chrysler Motors	93,640	65,879	94,727	404,344	350,764	+ 15.0	24.71	23.64	557,471	454,931	+ 22.4
Ford and Lincoln	96,802	101,498	86,575	419,067	340,528	+ 23.0	25.61	22.95	513,892	452,677	+ 13.3
General Motors	156,402	171,432	174,513	623,121	660,821	− 5.5	38.09	44.54	867,703	861,310	+ 0.7
All Others	44,853	46,468	36,929	189,588	131,482	+ 43.9	11.59	8.87	247,932	172,199	+ 44.0

Business in Brief

Written by the Guaranty Trust Co., New York

Business activity was well maintained last week, showing few signs of seasonal dullness. The weekly index of the New York *Journal of Commerce* stood at 101.1, as against 103.3 a week earlier and 88.5 a year ago. Retail trade, according to Dun & Bradstreet's estimate, was 2 to 8 per cent larger than in the preceding week and 12 to 22 per cent above the level for the corresponding period last year. Marked improvement in business sentiment was also reported in numerous quarters as a result of the improvement in the labor situation.

Carloadings Gain

Loadings of railway revenue freight during the week ended July 3 totaled 806,168 cars, showing an increase of 32,435 cars, or 4.2 per cent above the total for the preceding week and a gain of 156,465 cars, or 24.1 per cent, above that for the similar period a year ago. The exceptionally large gain above the 1936 figure was due to the fact that the latter was affected by the Fourth of July holiday.

Production of electricity by the electric light and power industry for the week ended July 3 was 10.3 per cent above that for the corresponding period last year. This gain compares with one of 11.6 per cent reported a week earlier and one of 11.3 per cent two weeks arlier.

Average daily crude oil production for the week ended July 3 amounted to 3,525,650 barrels, showing a decline of 3950 barrels from the average for the preceding week but remaining above the total of 3,423,800 barrels estimated to represent the restrictions imposed by the oil-producing states for July. Average daily output a year ago amounted to 2,892,300 barrels.

Production of bituminous coal last month, according to the preliminary estimate, totaled 31,560,000 net tons, as against 29,980,000 tons in May and 29,217,000 tons a year ago. Anthracite output amounted to 4,471,000 net tons, as compared with 4,207,000 tons a month earlier and 4,306,000 tons in the corresponding period last year.

The area of cotton under cultivation on July 1, according to the Department of Agriculture, was 34,192,000 acres, which is the largest in several years and is about 10.4 per cent above last year's acreage, but is small in comparison with the acreage figures generally reported for some years after the World War. Current estimates of the wheat and corn crops indicate large gains in yields of both grains as compared with last year's figures.

Fisher Index Continues Up

Professor Irving Fisher's index of wholesale commodity prices stood at 92.9 per cent of the 1926 average, as against 92.5 a week earlier and 92.0 two weeks earlier.

Reserve balances of member banks of the Federal Reserve system declind $73,000,000 during the week ended July 7. Reserve bank credit outstanding increased $16,000,000, the monetary gold stock $58,000,000, money in circulation $76,000,000, and Treasury cash $66,000,000.

Books

of automotive interest

"The Testing of Internal Combustion Engines," by S. J. Young and R. W. J. Pryer. Published by D. Van Nostrand Co., Inc., New York.

A text book on laboratory testing of internal combustion engines, primarily intended for use by students in engineering schools. Much of the data presented was assembled by the authors while teaching at Loughborough College in England, and all tabulated results and curves were obtained from experiments conducted at that institution.

An idea of the scope of the work can be obtained from the chapter headings which are: engine timing, brake horsepower tests, fuel consumption tests, indicator tests and applications of the indicator diagram, heat losses, measurement of air consumption and volumetric efficiency. A chapter is included on miscellaneous investigations concerned with the effect of ignition timing upon power and efficiency, service tests, manifold efficiency, exhaust gas analysis, calorific values of fuels, flash point, and viscosity.

Notes on dynamometer sizes and characteristics and the effect of dynamometer position upon torque readings are given in an appendix.

"How To Be A Good Foreman," by Charles Reitell. Published by the Ronald Press Co., New York.

The author presents his material on good foremanship in three separate phases: mastery of human elements, technical responsibility, and costs and budgetary control. Under the first subject heading, much practical information is given on hiring and training workers, obtaining the desired employe performance, and maintaining proper discipline and interest.

Part 2, which is concerned with technical responsibility, covers planning production, scheduling and orders, controlling materials, tools and spoilage. The third section of the book contains data on methods of accounting, cost analysis, and budgeting.

A number of subjects for discussion at foremen's meetings are suggested in the appendix.

Oil Marketer to Make Tires

Reports that one of the largest oil companies in the United States plans to take over the idle plant of the defunct India Tire Co. at Mogadore, Akron suburb, have been verified by S. L. Albert, general manager of L. Albert & Son, who own the property. Mr. Albert declares that the company will begin operating the factory as soon as Akron labor troubles clear up. The plant could produce upwards of 5000 tires per day. While refusing to reveal the identity of the prospective purchaser, Mr. Albert states that the company now is having its tires made by various independent manufacturers and is marketing tires in several thousand stations.

Chevrolet Adds Taxicab

New Model Built on 127-In. Wheelbase Has Turning Radius of 22 Ft.

Chevrolet has added a new taxicab to its regular line of 1937 models. According to the announcement of W. E. Holler, general sales manager of the Chevrolet Motor Div. of General Motors Sales Corp., the taxicab model is built on a 127-in. wheelbase, has a turning radius of 22 ft., right or left. Overall length is 202 in., with 8 3/16-in. clearance under the front axle and 8-in. clearance under the rear axle.

The new Chevrolet taxicab carries all major features of the regular line, plus some special adaptations to meet specific requirements of taxicab service. Among these is included a special joint behind the transmission, securely mounted to the frame cross-member and providing extra strength for the driving mechanism.

Rear axle is of the semi-floating type with extra strength and carrying capacity. Ring gear and pinion are housed in a one-piece banjo-type case.

A removable straight partition is provided between driver's and passenger's compartments. The partition can be easily replaced with a sedan-type of front seat, converting the car into a seven-passenger sedan after it has served its purpose as a taxicab.

. . . slants

BLACKSMITH'S LAMENT — *Shortage of skilled labor for shoeing horses. The pendulum of technological unemployment has taken a terrific backswing in the horse-shoeing art. Editorial in "The American Ironsmith" says "every available horseshoer that we have a record of is at work." A correspondent to the same journal reports "today one of the troubles is that there are not enough horseshoers to take care of the shoeing of horses."*

CAESAR'S GHOST — *Two thousand years ago Julius Caesar in his "Commentaries" wrote the first "travel blurb" for Lake Leman. On July* 10 *President Albert Lebrun of France, opened to traffic the Iseran Pass Highway, loftiest motor road in Europe, connecting Lake Leman with the Mediterranean Sea. At places, threading*

between mountain peaks, the road reaches an altitude of 9230 ft.

STUDY IN WINGS—*A comparative study of automobile "wings," or mudguards, or fenders, as they are called here, appears in "The Autocar" of London. Illustrated with line drawings, it shows the various styles currently in vogue on British, American and Continental cars. Interspersed in the text is a comment or two indicating that there are certain difficulties in the road use of the more extreme types, such as jacking, changing wheels and the like. Advantages of the newer wheel housings are appearance and ease in cleaning.*

C. R. OSBORN, formerly assistant general manager at Adam Opel A/G, General Motors' affiliate in Germany, has been appointed general manager. Since cooperative student days at the University of Cincinnati in 1916, Mr. Osborn has been associated with General Motors, and no other organization. He began his G.M. Export career as technical manager of the former Overseas Motor Service Corp., became its assistant manager in 1924 and its general manager and a vice-president of G.M. export in 1925.

E. R. PALMER arrived in New York July 5 to begin new duties as assistant controller of General Motors. Formerly general manager at Adam Opel (since July, 1936) he was with G.M. for 10 years prior to his Opel assignment beginning in 1929. At Opel he served successively as treasurer, assistant general manager, and general manager, replacing R. K. Evans in the latter position when Mr. Evans became a vice-president of G.M.

BEN BOALT, since 1931 vice-president, director and sales manager, Penn Electric Switch Co., Des Moines, Ia., has been elected vice-president of the Perfex Corp., Milwaukee, in charge of sales of its automatic control equipment division.

HOWARD W. SCHULTZ, assistant chief engineer of the Ohio Rubber Co., Willoughby, Ohio, since 1930, has been appointed chief engineer of that company.

Automotive Metal Markets

Steel Market Confidence Stronger As Labor Strife Eases; Parts Makers Order Strip for 1938 Model Stampings

What little effect strike disorders have had on steel market sentiment is giving way to confidence that a more orderly state of affairs has begun to set in. Fresh automotive demand, while so far light in tonnage, is noted in several descriptions of finished steel.

Parts makers have started to place orders for strip steel for 1938 model stampings. Sheet mills, especially those whose production was interrupted by walk-outs, still have good-sized backlogs on their books, virtually none of this business having been shifted to other plants. Automotive alloy steel specialists are much encouraged by tentative inquiries. While heavy export shipments of scrap iron and steel continue to furnish a prop for relatively high prices for one of the steel industry's chief raw materials, the picture of exports of semi-finished and finished steel as a bullish market factor appears to be greatly overdrawn.

During the first five months of this year semi-finished steel exports aggregated 117,833 tons and those of finished steel 434,347 tons. In that period, considered as having broken export records, our ingot production was around 24,000,000 tons, so that shipments abroad, high as they may have been when compared with those of preceding periods, can hardly be looked upon as very much of a depleting influence. The American Iron and Steel Institute now bases its reports of steel mill operations on an ingot capacity of 69,534,194 tons instead of 69,244,694 tons as heretofore, denoting an increase in the country's primary steel making capacity of 289,500 tons.

With the tin market once more close to 60 cents, an advance of between 4 and 5 cents per pound over the price a month ago, criticism of the International Tin Control Agreement is more outspoken than ever. Hamstringing of production is roundly denounced as being nothing more than a device to make a gamblers' paradise of the market. The American consumer pays today 50 per cent more for his tin than a year ago and displeasure is running high.

Heavy buying of zinc resulted in a ¼c. per pound mark-up. Cadmium has sold this week at as high as $2.10, while those who are covered by contracts pay only $1.60. The Chinese-Japanese clash beclouds the supply of tungsten and antimony. The latter comes in for relatively light use in automotive bearing metals, while the former serves in make-break contacts in ignition systems and in lamps, aside from its importance in machine tools.

Pig Iron—Talk of a $1 advance in fourth quarter prices persists.

Aluminum—Announcement that the sole producer will build a plant for the extraction of aluminum from bauxite at Mobile, Alabama, came as a development of major interest to the market, which quotably is unchanged.

Copper—Quiet and unchanged. Producers are reported to be sold out for deliveries before November.

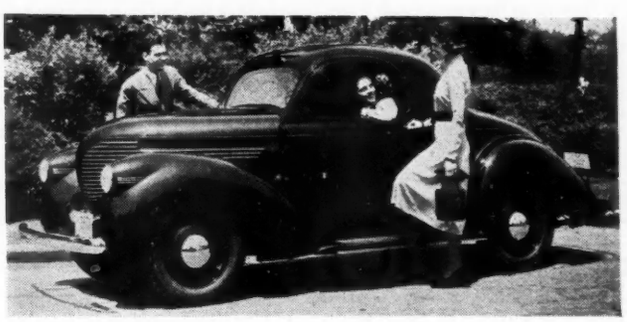
Tin—Spot Straits was quoted at 59¼ cents at the beginning of the week, but the market on Tuesday showed signs of moving into still higher ground, the price range being between 59¾ and 60 cents.

Lead—Steady and unchanged.

Zinc—Buyers were rather eager to cover their forward needs on the new price basis of 7 cents, East St. Louis.

L. GLIFFORD GOAD, general manufacturing manager of the AC Spark Plug division of General Motors, has been elected president of the Flint Industrial Executive's Club. Other newly elected officers are: vice-president, C. P. Nankervis, Fisher Body plant engineer; secretary, Fred C. Pyper, Buick master mechanic; treasurer, T. C. Downey, manager Chevrolet final assembly plant.

PRODUCTION



of this new Willys coupe model has started at the Toledo plants of Willys - Overland Motors, Inc., and will soon be extended to the Los Angeles Assembly unit. Designers have given special attention to roominess; the luggage compartment has a capacity of 38 cu. ft., the seat is 50 in. wide, and ample headroom is provided with a distance of 37 in. from seat to car top. The new model Willys coupe, fully equipped, is priced at $499 at the factory in Toledo, Ohio, excluding federal and state tax, freight and handling.

40 Years Ago

with the ancestors of AUTOMOTIVE INDUSTRIES

From Cleveland to New York

Combining business with recreation, Alexander Winton, president of the Winton Motor-Carriage Co., left Cleveland, Ohio, with a companion on a new single-seated motor-carriage on the morning of July 28, and after a leisurely journey (two days including Sunday being used for resting), he reached New York City, Saturday, Aug. 7, passing through Rochester, Syracuse, Utica and Albany.

The object of the trip was to test the motor in a long journey over all kinds of roads, and from Mr. Winton's account no greater test could have been given the machine, as, to use his own words, "The roads were simply outrageous."

Though on the road nine days the actual running time was 78 hours and 43 minutes, and he is certain that owing to the innumerable grades and hills and the circuitous routes in quest of better roads, he traveled fully 800 miles.

From *The Horseless Age*, July, 1897.

Plant Notes

New Building Activity Worldwide As Many Companies Add Capacity

The first forge plant built for a GM overseas operation has been added to the Adam Opel organization. Ground was broken just a year ago for the new Opel division which included a hammer and die shop and power plant to supply increased demand from the whole works. The forge building is 850 ft. by 80 ft. by 40 ft., and has a steel storage yard running the length of the building.

Supervised by George W. Motherwell, manager of the forge division, hammer designs were converted from Chevrolet types and upsetters of American Ajax design were built in Germany. Other plant details were also modeled on the Chevrolet forge plant at Detroit, said to be one of the most modern in the world.

Solemn rites by Shinto priests, propitiating Inari, god of business prosperity, preceded the opening of a new parts-stock building for General Motors Japan, which celebrated its tenth anniversary on April 8, the official birthday of the Buddha. The Japanese plant now has 800 employes. W. T. Lutz, as managing director, is one of a small handful of Americans attached to the plant.

Decision to invest between $3,000,000 and $4,000,000 in plant enlargement and improvement this year has been made by Allis-Chalmers Mfg. Co., Milwaukee, according to an announcement by Gen. Otto H. Falk, board chairman.

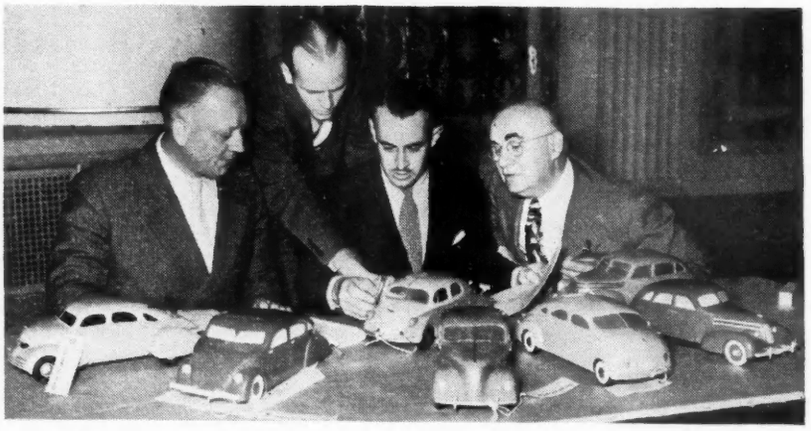
About $1,500,000 will be used for expansion of the tractor works and $1,000,000 to increase facilities for manufacturing tractor tools and other farm equipment. Boiler house of the main works in West Allis, Milwaukee suburb, will be reconditioned immediately at a cost of $800,000. The track-type and heavy-duty tractor works at Springfield, Ill., already have been enlarged at a cost of $1,000,000 during the past year. H. C. Merritt is vice-president in charge of all tractor activities.

Construction of a modern two-story building for the AC Spark Plug division of General Motors at its Dort highway plant site will be undertaken this month. The new building, with 21,000 sq. ft. of floor space, will house an enlarged plant hospital, personnel offices, and manufacturing offices of the Dort highway plant. It is expected that it will be ready for occupancy within 90 days. The construction is a part of the factory revamping and expansion program instituted three years ago by Fred S. Kimmerling, president and general manager.

Plant and offices of the Wheel Service Equipment Corp. have been moved from 1718 Brush Street to 407 East Fort Street, Detroit, to care for increased business. The company manufactures wheel and brake service equipment and tools. F. A. Tripp is vice-president and general manager.

Additional production space of 6000 sq. ft. will be provided by a new building now being completed for the Perfex Corp., Milwaukee, manufacturer of automobile, truck and industrial engine radiators, and a general line of automatic controls for air-conditioning systems. Frederick D. Hansen is executive vice-president.

General Foundries Co., Milwaukee, is equipping a new building, 180 by 200



JUDGING miniature automobiles entered in the Fisher Body Craftsman's Guild model car design competition. Representatives of General Motors styling section and members of the Guild technical staff are now engaged in selecting winning designs. Shown left to right, are: Frank C. Riess, of the educational foundation; William L. Mitchell and Theodore C. Hobbs, two of the automotive concern's chief designers; and Walter Leuschner, of the Guild technical department. Boy entrants, vying for state and regional honors, submitted a large number of rear-engined jobs, some of pure teardrop design, others with a semblance of a hood. On some models the bumpers were joined to the body with no space intervening, running boards were eliminated, and others were designed for increased rear vision.

May Exports Gain 34 Per Cent Over '36

May and Five Months Ended May, 1937-1936

	MAY 1937		MAY 1936		FIVE MONTHS ENDED MAY 1937		1936	
	No.	Value	No.	Value	No.	Value	No.	Value
EXPORTS								
Automobiles, parts and accessories		$ 33,168,892		$ 22,531,868		$ 146,339,972		$ 113,684,770
PASSENGER CARS								
Passenger cars and chassis	23,294	13,995,125	17,570	9,576,502	105,194	62,238,472	85,668	49,100,961
Low price range $850 inclusive	21,165	11,666,273	16,224	8,016,834	95,742	51,750,726	78,238	40,803,524
Medium price range over $850 to $1200	1,777	1,675,103	1,043	1,017,208	7,705	7,306,011	61,106	5,873,319
$1200 to $2000	259	392,563	221	326,288	1,268	1,955,163	893	1,308,529
Over $2000	93	261,186	82	216,172	479	1,226,572	431	1,115,595
COMMERCIAL VEHICLES								
Motor trucks, buses and chassis (total)	14,773	8,446,140	10,806	5,383,814	61,137	33,799,657	48,689	24,356,568
Under one ton	1,770	706,107	1,551	607,172	7,578	2,880,593	7,239	2,714,257
One and up to 1½ tons	9,711	4,637,550	7,280	3,303,660	42,205	19,660,938	31,917	14,598,072
Over 1½ tons to 2½ tons	2,467	1,749,766	1,349	936,703	8,183	6,372,396	6,516	4,588,097
Over 2½ tons	593	1,193,299	321	376,611	2,579	4,449,257	1,462	1,801,657
Bus chassis	232	159,418	305	159,668	592	436,473	1,555	
PARTS, ETC.								
Parts except engines and tires		5,343,007		4,004,412		25,898,336		22,753,191
Automobile unit assemblies		3,366,296		2,454,283		15,386,796		10,818,621
Automobile parts for replacement (n. e. s.)		623,493		412,857		2,724,300		1,803,861
Automobile service appliances								
Airplanes, seaplanes and other aircraft	54	1,907,154	35	739,932	230	7,604,105	149	2,540,975
Parts of airplanes, except engines and tires		747,296		568,089		3,299,927		1,840,203
INTERNAL COMBUSTION ENGINES Stationary and Portable								
Diesel and semi-Diesel	93	178,257	27	66,014	354	750,933	162	549,092
Other stationary and portable								
Not over 10 hp.	1,227	86,754	970	57,818	9,251	502,645	4,540	302,853
Over 10 hp.	595	200,699	150	67,763	1,581	724,725	1,160	411,411
Automobile engines for:								
Motor trucks and buses	2,996	287,465	1,150	93,790	15,140	1,502,330	11,049	1,047,543
Passenger cars	11,262	755,597	3,997	245,234	45,002	3,021,384	25,612	1,733,380
Engines and aircraft	130	728,643	51	229,575	486	2,751,975	265	1,258,395
Accessories and parts (carburetors)		263,513		180,212		1,151,312		839,055
IMPORTS								
Automobile and chassis (dutiable)	126	141,530	69	34,968	559	425,994	274	116,712

ft., adjoining its main foundry at a cost of about $50,000. It is expected that the additional facilities will increase capacity from 30 tons a day to 50 tons. Frederick Busche is president.

Month of '37 Production

(Continued from page 71)

ports that there are unfilled orders for 100,000 cars still on the books, but that it is expected some will be carried over for next season. Another is shipping new cars to dealers as fast as they come off the lines to fill out field shortages.

Hudson Motor Car Co. will assemble somewhat over 2000 cars this week against 1870 last week, and against about 3500 a week during the spring peak.

Cadillac Div. of General Motors broke all volume records this week when the factory shipped its 40,966th car of the 1937 series. The highest previous model output in the 35 year history of the company was on the series which went into production July, 1928 and ran through June, 1929.

Nash div. of Nash Kelvinator Corp. shipped 8780 cars in June, the best June since 1929. Shipments for months ended June 30 were 56,587 cars against 27,214 for the like period of 1936.

Hupp Motor Car Corp. will be in production on its new models early in August and plans announcement the latter part of the month.

White Motor Co. achieved a twelve-year peak for truck and bus deliveries during June. As reported by Robert F. Black, president, deliveries for the past month totaled 1300 units, an increase of 25 per cent over the same month last year and 48.1 per cent above those for June, 1935.

Willys-Overland Motors, Inc., produced 7154 Willys cars in June. Total production since November, 1936 has reached 53,648 units. Production on the new coupe model is now running about 25 per cent of total.

Studebaker Corp. reported sale of 10,140 passenger cars, and trucks in June. This figure compared with 7573 in June, 1936 shows an increase of 34 per cent.

Studebaker Added 561 Outlets in 6 Mos.

Studebaker appointed 99 new dealers in June, bringing the total of new appointments for the half-year to 561, according to George D. Keller, vice-president in charge of sales.

Calls Safety Work Failure

(Continued from page 75)

C. C. C. camps, reduced accidents 50 per-cent.

"The lighting field also contains many opportunities. Very little progress has been made in recent years in improving automobile lights. A fortune awaits the inventor of a headlight which will penetrate fogs, not blind approaching motorists and remedy many other defects of existing systems.

"Present body designs, which unquestionably lower driver visibility and lead to accidents, offer other opportunities.

"Cost, of course, must be kept in mind in making improvements. Competition, particularly in the low-priced car field, is so keen that every penny of added cost is weighed carefully by manufacturers. Truly, the person who can design a safer car and not add to manufacturing costs has something worth developing.

"Do not be discouraged by the oft-repeated statement that cars today are 'made as safe as human ingenuity can make them.' This statement will not bear analysis."

New Sleeper Coach Built

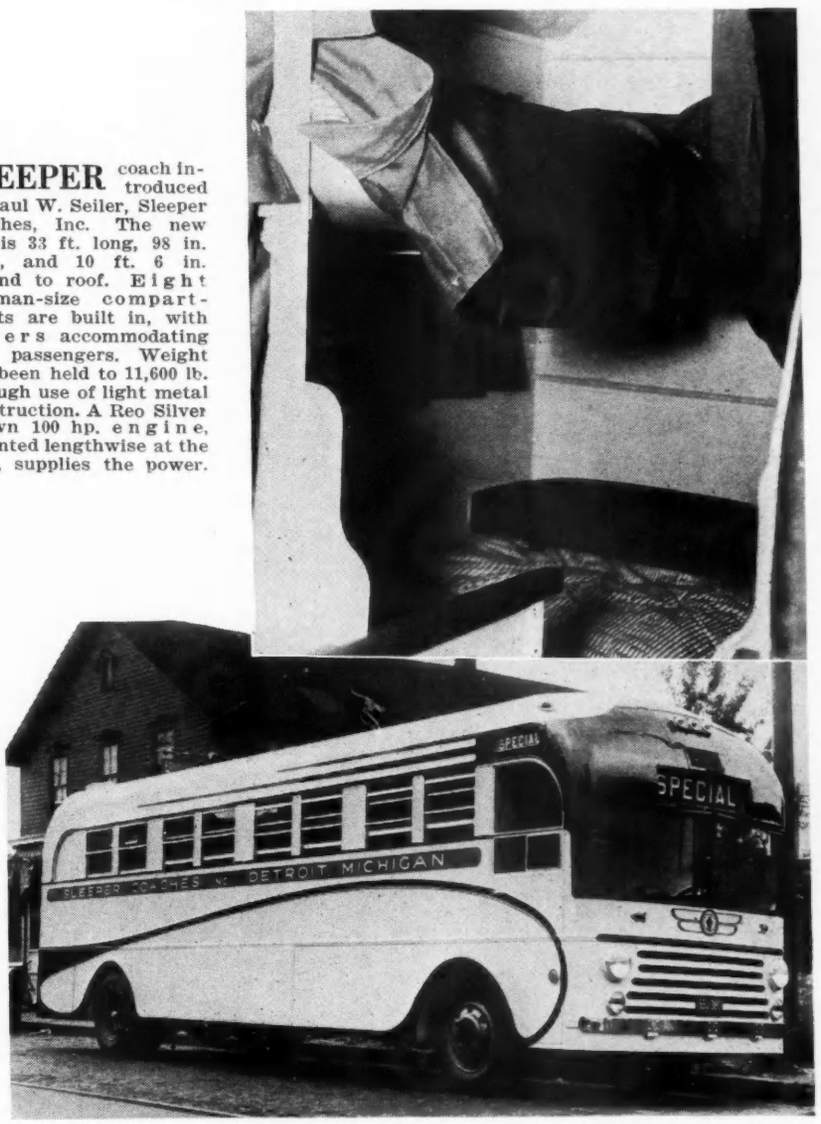
Weight Held to 11,600 lb. by Light-Metal Construction; Reo 100 Hp. Engine Mounted at Rear

An experimental sleeper coach was demonstrated in Detroit this week by Paul W. Seiler, who has formed Sleeper Coaches, Inc. The coach was designed by H. G. McCarroll, and Mr. Seiler, former president of the General Motors Truck Co., is sole owner of coach and patent rights.

The sleeper unit is 33 ft. in length, 96 in. wide, and 10 ft. 6 in., ground to roof. It contains eight standard Pullman-size compartments, with lowers accommodating two passengers. Lavatory facilities are provided, said to be the first in any sleeper bus.

Through use of light-weight Dowmetal construction, weight has been held to 11,600 lb. It is claimed that the coach is about 9000 lb. lighter than any sleeper bus now on the road, and that it weighs 7000 lb. less than any conventional bus of similar capacity. Dowmetal sheet and extruded forms are used throughout the unit. The Dow Mfg. Co., Midland, Mich., has a contract to build single units on an experimental cost basis, and while the company is not interested in volume production, it is prepared to supply the Dowmetal materials to coach or body builders who may become Sleeper Coach licensees.

Power plant of the bus is a standard Reo Silver Crown 100 hp. engine which is mounted length wise at the rear, the drive to the wheels being taken directly through two short side shafts, each fitted with two universal joints. Engine, transmission, and differential are in one unit. Single, 8.25 by 20 in. tires are standard equipment. Chassis frame is of Reo design and fabricated from Duralumin forms.



SLEEPER coach introduced by Paul W. Seiler, Sleeper Coaches, Inc. The new bus is 33 ft. long, 98 in. wide, and 10 ft. 6 in. ground to roof. Eight Pullman-size compartments are built in, with lowers accommodating two passengers. Weight has been held to 11,600 lb. through use of light metal construction. A Reo Silver Crown 100 hp. engine, mounted lengthwise at the rear, supplies the power.

Wagner Act Test

(Continued from page 73)

will take the position that the Wagner Act results in unwarranted interference with the right of a manufacturer to run his own business if it prevents him from discharging men for just cause.

Hearings continued before Judge John T. Lindsay this week in the Federal Building. Numerous witnesses, men and women, appeared to give their versions of the May 26 battle in which several union organizers were injured.

Ford Shuts Down

Vacation and Inventory Plan Affects Manufacturing and Assembly

The Ford Motor Company's Rouge plant and its two-score other plants and branches throughout the United States closed July 16 for the annual inventory and vacation period. Ford employes will be called back August 9 to work on a 6,000-a-day schedule.

The closing will not affect the blast furnaces, coke ovens, cement plant, open hearth mill, the merchant mill and cold finishing mill, the glass plant or the paper mill. The jobbing foundry, pattern shop, tool room, blacksmith shop and engineering departments all will remain open during the shutdown. In addition, a number of other departments will be obliged to work part time during the vacation period to maintain schedules.

Approximately $400,000 has been paid to 20,000 Ford employes within the last few days, representing their semi-annual returns on savings in the Ford Investment Plan.

The employes' savings total and the volume of payments are the largest since 1932. Employe savings aggregated $13,300,000 on July 1. Both savings and returns increased by approximately 20 per cent during the last year.

Under the Ford Investment Plan, which has been in operation since 1920, employes are permitted to pay into the Investment Plan fund as savings up to one-third of their salaries or wages.

Returns are paid semi-annually at a rate guaranteed to be not less than four and one-half per cent annually. Usually the rate is considerably higher. The present rate of return is seven per cent annually.

The majority of the employes benefitted are in the Rouge and Highland Park Ford plants and nearby "village" plants. The balance are scattered in two-score Ford plants and branches throughout the United States.

AUTOMOTIVE INDUSTRIES

Looks Ahead

HYPOIDS. Since the introduction of hypoid-gear rear axle assemblys in production cars, numerous detail changes have been made in their design. Beginning soon, we shall add to the series of engine drawings which have been appearing weekly, a number of section drawings of typical hypoid assemblys. Several of the drawings are already in preparation for printing, and will supplement, instead of replacing the engine drawings in a particular issue.

VERY GRATIFYING was the response to our recent bid for expressions of readers' interest in the engine-drawing series. Arrangements have been made to reprint (as Series I) in handy form the entire series as it will appear to Oct. 16 next. The price will be nominal and a reservation for a set now entails no future obligation.—The Editor.

Rubber Labor Probe Coming

Headquarters of the United Rubber Workers of America, affiliated with the C.I.O. in Akron, have received notice to the effect that the National Labor Relations Board will send special trial examiners into Akron Aug. 9 and 12 for hearings on petitions of the Goodyear and Goodrich U.R.W. locals for collective bargaining with those respective companies. The Goodyear hearing will be on Aug. 9 and the Goodrich hearing on Aug. 12. The U.R.W. petitions to the N.L.R.B. followed the negotiation of the first C.I.O. contract with a major tire company (Firestone) which ended the Firestone strike last April. Firestone agreed to recognize the U.R.W. for such employes as elected to have the union represent them.

Calendar of Coming Events

SHOWS

Second Winter Item Show, Automobile Accessories Association, Chicago, Aug. 9
Poland, Automobile Salon (Foire Orientale), Lwow .....Sept. 1-15
Yugoslavia, Automobile Section, Autumn Fair, Ljubljana .....Sept. 1-12
Yugoslavia, Automobile Section, Commercial Fair, Belgrade.....Sept. 11-21
France, 31st International Automobile Salon, Paris .....Oct. 7-17
Great Britain, 31st International Automobile Exposition, London....Oct. 14-23
Czechoslovakian Automobile Show, Prague .....Oct. 16-24
National Automobile Show, New York, Oct. 27-Nov. 3
Toledo, O., Automobile Show..Oct. 27-Nov. 3
Italy, 10th International Automobile Salon, Milan .....Oct. 28-Nov. 8
Boston, Mass., Automobile Show, Oct. 30-Nov. 6
Los Angeles, Cal., Automobile Show, Oct. 30-Nov. 7
San Francisco, Automobile Show, Oct. 30-Nov. 7
Cincinnati Automobile Show.Oct. 31-Nov. 6
Great Britain, 13th International Commercial Automobile Exposition (trucks and buses), London...Nov. 4-13
Chicago Automobile Show.....Nov. 6-13
Akron Automobile Show.....Nov. 6-12
Omaha Automobile Show.....Nov. 6-11
Brooklyn Automobile Show.....Nov. 6-13
Columbus Automobile Show .....Nov. 6-12
Detroit Automobile Show.....Nov. 6-13
Motor Truck Show, 4th Annual, Newark, N. J. .....Nov. 6-12
Newark, N. J., Truck Show.....Nov. 6-12
Buffalo, N. Y., Automobile Show..Nov. 6-13
Indianapolis, Automobile Show....Nov. 6-13

Show Business

Manager of the National Automobile Show in New York is Alfred Reeves, 366 Madison Ave., N. Y. C. Inquiries concerning all matters connected with the national show should be addressed to him. AUTOMOTIVE INDUSTRIES will be pleased to furnish names and addresses of local show managers on request.

Newark, N. J., Automobile Show..Nov. 6-13
Philadelphia Automobile Show....Nov. 6-13
Pittsburgh, Pa., Automobile Show.Nov. 6-13
Toronto, Ont., Automobile Show..Nov. 6-13
Great Britain, 36th Scottish International Automobile Exposition, Glasgow .....Nov. 12-20
Baltimore, Md., Automobile Show, Nov. 13-20
Cleveland, Ohio, Automobile Show, Nov. 13-20
Jersey City, N. J., Automobile Show, Nov. 15-20
Milwaukee, Wis., Automobile Show, Nov. 17-24
Springfield, Mass., Automobile Show, Nov. 14-20
St. Louis, Mo., Automobile Show.Nov. 14-21
Portland, Ore., Automobile Show.Nov. 14-21
Denver, Colo., Automobile Show, Nov. 15-20
Montreal, Que., Automobile Show, Nov. 20-27
Kansas City, Mo., Automobile Show, Nov. 27-Dec. 4
A.S.I. Show, Navy Pier, Chicago, Dec. 6—Dec. 11

CONTESTS

National and International Soap Box Derby Finals, Akron, Ohio.....Aug. 15
Pan American Cup Race, Roosevelt Raceway .....Sept. 6
National Outboard Championship Regattas, Richmond, Va.....Sept. 18-19

CONVENTIONS AND MEETINGS

U.A.W. Annual Convention, Milwaukee, Aug. 23
International Congress on Carbohydrate Carburants, Rome .....Sept. 10-12
S.A.E. Section Regional Tractor Meeting, Akron, Ohio.....Sept. 15-17
American Transit Association, 56th Annual Convention, White Sulphur Springs, W. Va.....Sept. 19-23
S.A.E. Section Regional Transportation Meeting, Chicago .....Sept. 29-Oct. 1
American Foundrymen's Association Midyear Meeting, Columbus, Ohio, Sept. 30-Oct. 1
S.A.E. Fuels and Lubricants Regional Meeting, Tulsa, Okla. ...Sept. 30-Oct. 1
S.A.E. National Aircraft Production Meeting, Los Angeles, Calif.....Oct. 7-9
American Foundrymen's Association, Regional Conference, Rolla, Mo., Oct. 8-9
National Metal Congress, Atlantic City, Oct. 18-22
S.A.E. Annual Dinner, Commodore Hotel, New York.....Oct. 28
American Petroleum Institute, 18th Annual Meeting, Stevens Hotel, Chicago .....Nov. 8-12
S.A.E. National Production Meeting, Flint, Mich. .....Dec. 8-10

Courtesy The Aluminum Co. of America

Automotive Materials

5

The commercial history of light metals is closely identified with the growth of the automotive and aircraft industries. Many improvements in modern transportation equipment, especially the development of engines with higher horsepower and drastic reductions in weight of component engine parts and body structures, have been possible only because of the availability of suitable alloys of aluminum and magnesium.

Refinements in metallurgy and fabricating are emphasized in this fifth article in the Automotive Materials Series in which we have endeavored to present a technically authoritative picture of progress in the light metals field. Next month, the August 21 issue of Automotive Industries will carry the story of new developments in rubber products (excluding tires) for application to automotive vehicles.

LIGHT METALS

Trends in Design of Modern Transportation Equipment Lend Increasing Significance to the Applications of Aluminum and Magnesium Alloys

By H. E. Blank, Jr.

CLOSELY related to the trend in automotive and aeronautical design toward more horsepower and less weight are the advances made in manufacture and fabrication of light alloys of aluminum and magnesium. These alloys, because of their characteristic properties of light weight, high strength, high thermal conductivity, ease of finishing, and pleasing appearance, are very desirable materials for many component parts of automobiles and aircraft.

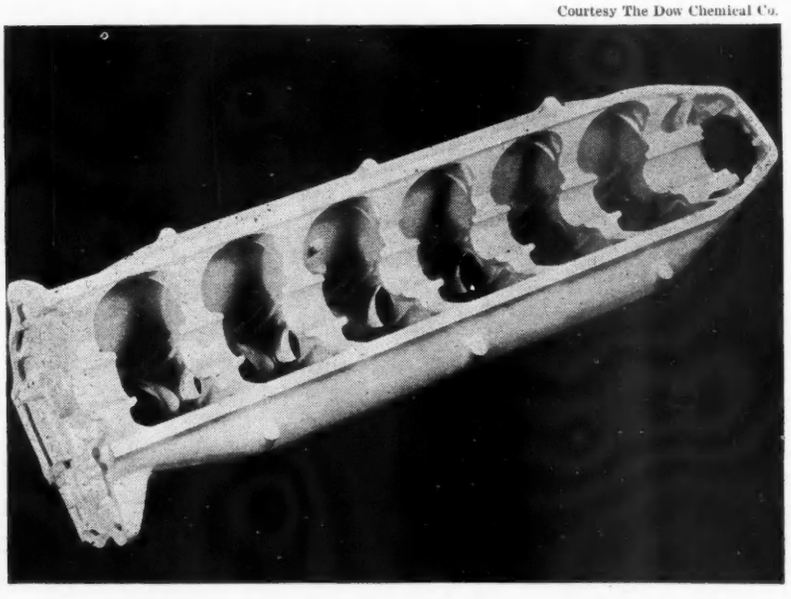
Applications of light metal alloys in the automotive field include pistons, crankcases, oil pans, bearing caps, cylinder heads, and brake shoes. Appreciable reductions in vibration and bearing wear are made possible by light-weight pistons. For automotive engine pistons it is necessary to use an aluminum alloy which has the required uniform strength and hardness at operating temperatures, resists ring groove wear and deformation, and has good bearing characteristics. Virtually all of the aluminum pistons now being used in passenger car engines are cast by the permanent mold method. Pistons made by this process can be heat treated to better advantage than those which are sand cast; further, dimensional accuracy and finish are additional advantages of permanent mold castings. Within recent years an aluminum alloy was developed which was found to be especially well suited for pistons. Its coefficient of expansion is much lower than the ordinary aluminum copper piston alloy and weighs approximately 7 per cent less. The alloy also has the properties, particularly desirable for this application, of high thermal conductivity and good bearing characteristics.

With this alloy, known in the trade as Lo-Ex, it is possible to make pistons plain and cylindrical which can be fitted to relatively low clearance. Pistons of this alloy, of the so-called T-slot design, have many points in their favor which include lightness, low friction, large bearing area, efficient heat dissipation, and ruggedness.

Reductions in engine weight are effected by making crankcases and oil pans of light metal alloys. When aluminum alloys are used for this purpose, crankcase oil temperatures are lowered due to the high thermal conductivity of the metal. If crankcases are of light metal it is essential that bearing caps should be of the same material so that bearing concentricity will be maintained. Because of high strength requirements, forgings have been found most desirable for this application. Heat-treated castings, however, are occasionally used.

The high thermal conductivity property of alumium alloys makes them especially suitable material for cylinder head castings. They make possible higher compression ratios, increased power, and improved volumetric efficiency due to the more uniform and cooler cylinder head temperatures. Light metal cylinder head castings are generally semi-permanent mold and sand castings of alloys designed for pressure-tight castings and with the

Courtesy The Dow Chemical Co.

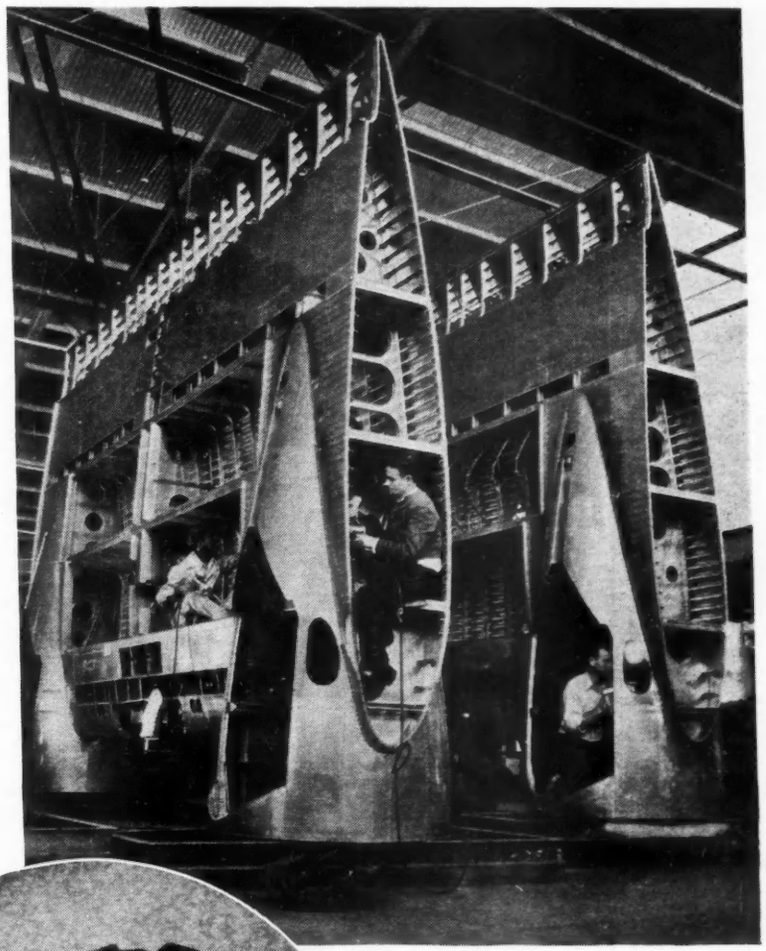


essential corrosion resistance.

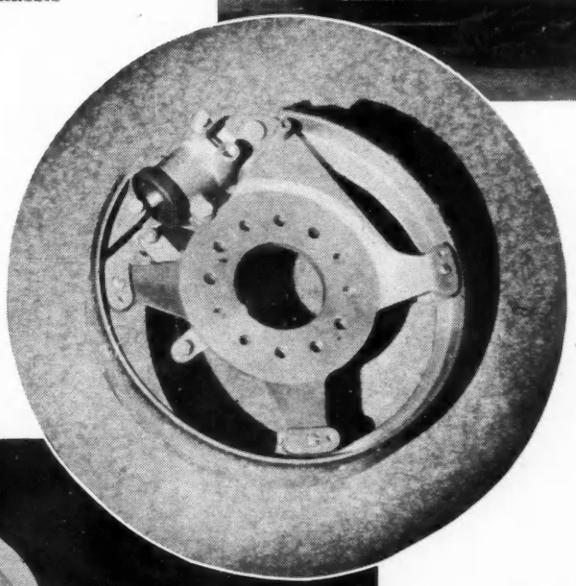
Aluminum alloy brake shoes are said to improve braking action due to their thermal conductivity and expansion properties. Corrosion resistance is also a highly desirable factor in this application.

It was pointed out by G. D. Welty, Aluminum Company of America, in his article "Fifty Years of Aluminum and the Automobile Industry" which was published Feb. 15, 1936, in AUTOMOTIVE INDUSTRIES, that forged aluminum connecting rods may be used more extensively for automobile engines as problems of bearing loading and temperatures become more acute.

The alloys of aluminum are also used in the automobile industry for structural members in trucks, commercial trailers, and buses. The light metal is utilized to great advantage in the skin-stressed or monocoque design in which type of construction the chassis



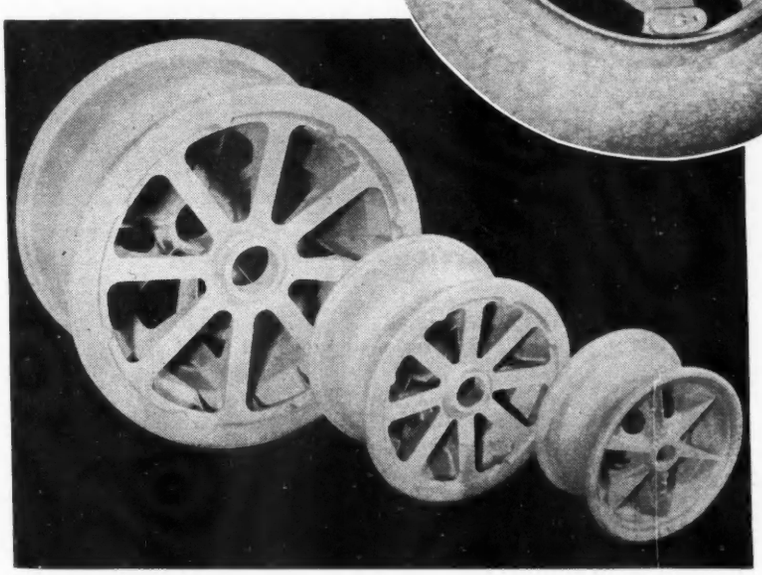
(Above) Fabricating the center wing sections for transport airliners from aluminum alloy



(Circle) Magnesium alloy parts are used in this brake assembly, a product of the Automotive Fan and Bearing Co.

(Opposite page) Sandcast crankcase of magnesium alloy used on Menasco aircraft engine

(Below) Magnesium alloy sandcast airplane wheels



is eliminated. Alloys for this purpose have high strength-weight ratio and are made in panel sheets sufficiently thick to withstand buckling. An example of results obtained by eliminating weight through this type construction is provided by comparison between a semi-trailer body of aluminum alloy monocoque design which was 42.5 per cent lighter and carried 6000 lb. more pay load than a conventional wood-steel body on the same steel semi-trailer.

Various factors have been responsible for the increasing use of commer-

cial shapes and plates of aluminum as structural material for fabrication into trucks and buses. In addition to reduction of weight to achieve more economical operation, certain highway restrictions and taxes have strengthened the trend. A recent analysis, however, revealed that weight saved in manufacture of commercial vehicles was the primary reason for specifying light metal as the structural material.

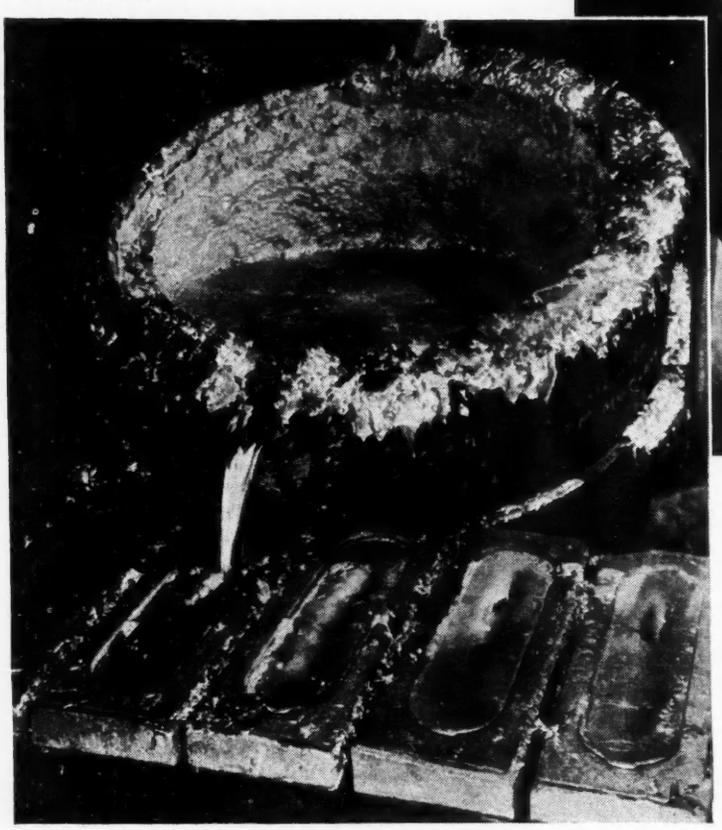
Alloys of magnesium are also used in the automotive industry for truck bodies and trailers, an application made possible by development of large sheets and structural sections. It is reported that weight reduction effected in building bodies of magnesium alloy members are approximately 25 per cent as compared to other light alloys and almost 75 per cent of conventional wood and steel construction. Automobile engine castings, bus seats, resonator horn discs are a few other parts made of magnesium alloys. Other applications of magnesium are discussed in detail in the second section of this article which is devoted exclusively to alloys of magnesium.

The needs of the aircraft industry have played a major role in stimulating developments in light metals. In keeping with these demands, the makers of aluminum alloys increased the minimum yield strength of aluminum alloy sheet 100 per cent in less than 20 years. Today the guaranteed minimum yield strength for some aluminum alloy sheet is 50,000 lb. per sq. in.

In general, the requirements of the aircraft industry pointed for sheets wider, longer, thinner, and flatter. Tubes were needed in greater variety of wall thickness, length, and shape. Indication of real progress lies in the fact that aluminum alloy sheets, not possible to produce a decade ago, are now commonplace in many combinations of thicknesses and widths such as 0.016 in. by 36 in. by 168 in. Tubes are being produced at the present time up to and including those with a major axis of approximately 11 in. and in lengths of about 25 ft. Further progress is emphasized by the fact that in 1920 strong aluminum alloys could not be made in extruded forms in thicknesses less than ⅛ in. Modern manufacturing has made possible regular production of much lighter extruded sections. It is reported that, whereas in 1925 much less than 10 per cent of the structural weight of aircraft built in the United States consisted of aluminum alloys, recent analyses and surveys show approximately 90 per cent of the net weight of modern military and transport airplanes to be aluminum.

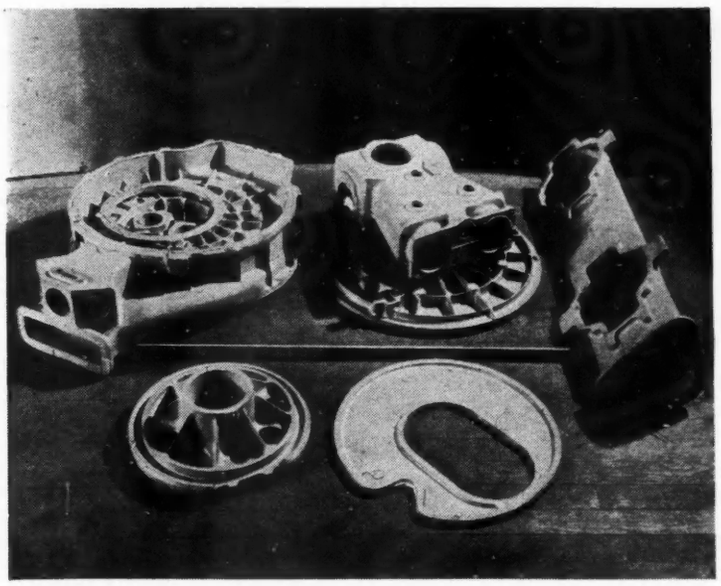
Commercial grade aluminum has a minimum of 99 per cent pure aluminum and alloys readily with silicon, copper,

Bourke-White photo



(Above) Pouring an aluminum alloy permanent mold casting

(Left) Pouring aluminum pigs



(Left) Magnesium alloy sand castings for Wright aircraft engine

iron, manganese, magnesium, zinc, chromium, titanium and nickel. The alloys of aluminum may be cast in green or dry sand, permanent molds or formed by die casting. Virtually all of the wrought aluminum alloys are marketed today in the commercial forms of plate, sheet, strip, foil, wire, rod bar, tubing, forgings, extruded shapes, and rolled billets, bars and shapes.

The two types of heat treatment which can be used to increase strength properties of heat treatable aluminum alloys include a high temperature solution treatment and a lower temperature precipitation treatment. The latter is called "aging." Essentially, the solution heat treatment process involves subjecting the alloy to high temperature in a nitrate bath or air furnace. When casting alloys of aluminum are subjected to this process they are treated only in the air furnace.

It is recommended in solution heat treatment of wrought alloys that the part should be quickly quenched in cold water. Alloys quenched slowly are apparently more susceptible to intercrystalline corrosion. On the other hand, castings are sometimes quenched in oil or boiling water so that quenching stresses and distortion will be minimized. Alloys of the duralumin type will age at room temperature after they have been given a solution heat treatment and aging is virtually complete within four days. Other alloys are artificially aged at elevated temperatures. Some casting alloys are also subjected to the procedure to increase their strength and hardness.

Fabricating aluminum alloys by riveting has been refined to high degree, but in lieu of economies to be gained, a great deal of attention has been given to the development of proper welding technique.

Inasmuch as the electrical conductivity of aluminum alloys is relatively high, spot or seam welders must supply a much greater amperage than is necessary to weld most other materials. Making a good spot weld is based on formation of a molten spheroid between sheets, melting being intensely localized so that outer surfaces are affected very little.

Most important in design of machines for welding aluminum alloy is the control of the power supply. To obtain the required high thermal gradient, power applications must be short, values in general extending from ½ cycle (assuming 60 cycle power supply) to 6 or 8 cycles for gages of material up to about 1/16 in.

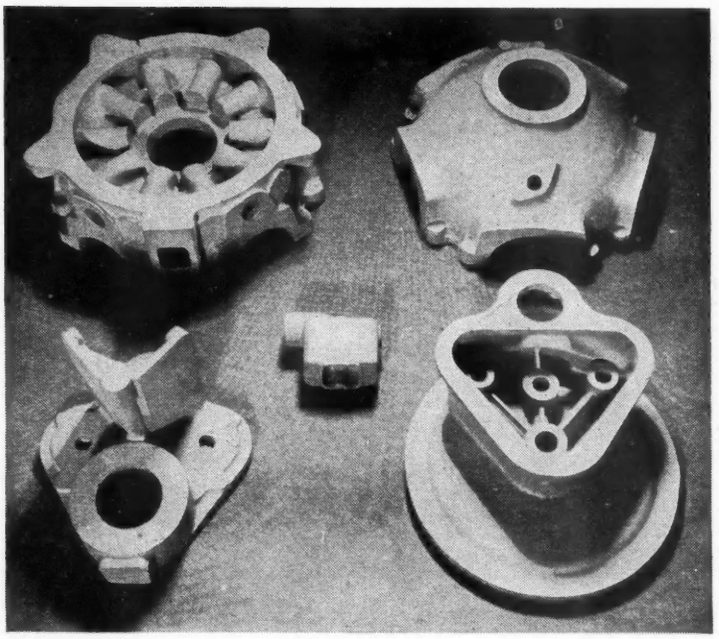
An electrode with conically shaped tip has been found quite satisfactory for all gages of material. Electrode pressures now used vary from several hundred pounds to approximately 1000 lb. for material of 1/10 or ⅛ in thickness. (Refers to strong aluminum alloys.) Some common non-heat treatable alloys, particularly in the annealed temper, have lower yield point and lower pressure must be used.

Surface conditions play an important role in spot and seam welding of alloys. All aluminum alloys have an oxide surface the resistance of which is much greater than that of metal itself. With most common alloys, the oxide film is of sufficient resistivity to permit a proper weld and yet not cause excessive heating where it contacts the electrodes. In most cases, surfaces of common alloys need not be cleaned or otherwise treated prior to spot welding.

There is no basic difference between spot and seam welding. Seam welds may be classified into continuous and intermittent, and continuous seam is formed by adjusting the welding equipment so that it will provide successive shots of synchronous power, so timed that, in conjunction with the electrode wheel speed, the successively formed spots overlap. To provide proper proportion of molten zone thickness to sheet thickness, percentage of time during which power is applied should not, generally, exceed 25 per cent. Percentages considerably less than this have been used successfully. For instance, one adjustment used with 0.064 in. thick sheet of one of the common light metal alloys, was 2 cycles on, 7 cycles off, with a wheel speed of 3½ ft. per min. With proper equipment, spot and seam weld strength should not vary beyond the range between 90 per cent and 110 per cent of average strengths. Fatigue data, though not very comprehensive, have been consistent and comparable with those obtained on riveted joints.

Principal factors determining resistance to corrosion of aluminum alloy structures are: composition and temper of alloys, details of design, and conditions of service. Atmospheric tests have been found to be the most reliable indicators of corrosion resistant properties. A characteristic test uses (standard A.S.T.M.) tension test specimens machined from 14 to 18 gage sheet. No protective coatings are applied and the specimens are placed in frames exposed at an angle of 45 deg. to the horizontal. Tension test specimens are employed because it has been shown that losses in mechanical properties are reliable criteria of the extent of corrosion of aluminum and its alloys, whereas changes in weight and appearance are not.

Several accelerated laboratory tests are also available. The most rapid of these, introduced by the Bureau of Standards, consists in alternate immersion of the specimen in a solution of sodium chloride and hydrogen peroxide (0.9 normal sodium chloride plus 0.3 per cent hydrogen peroxide). Temperature is maintained at 30 deg. C. dur-



(Right) Lambert aircraft engine parts sand cast of magnesium alloy

ing the test and a three minute cycle is used, 1½ min. in the solution and 1½ min. in the air. Two other tests are also now in use: one, the outdoor alternate immersion test in which specimens are immersed in a 3½ per cent sea salt solution for 10 minutes each hour; the other consists of exposing specimens to a continuous spray of a 20 per cent salt water solution.

Alclad sheet, which consists of a heat-treated strong aluminum alloy base protected from corrosion by smooth, dense surface layers of high purity aluminum, alloyed with the core, was brought out in 1927 by the Aluminum Co. of America. Thickness of each pure metal surface layer is very uniform; it is 5½ per cent of the total thickness of the sheet.

The alloy has unusually high corrosion resistance attributable to the high purity aluminum surface which is inherently highly corrosion-resistant and also to the fact that the pure aluminum provides electrolytic protection over cut edges of the sheet or other areas where the alloy base is exposed.

Unit strengths of Alclad materials are somewhat lower than comparable items without the pure aluminum coating. This is, of course, attributable to the lower strength of the high purity aluminum coating. For instance, loss in tensile strength ranges from about 5 per cent to 9 per cent and loss in yield strength from about 7 per cent to 9 per cent. Reduction of unit strength of the material may seem to indicate increase in weight of the structure. However, the difference in weight is actually reduced because of the extra weight of the protective coatings applied to materials which do not have the pure aluminum surface.

In the United States, light alloys of magnesium are marketed as the A.M. series of alloys made by the American Magnesium Corp., and as Dowmetal made by the Dow Chemical Co.; in Europe as Elektron metal. Commercial alloys of magnesium usually contain about 90 per cent base metal combined with aluminum, silicon, zinc, and manganese. Their density averages 1.80, less than one-fourth that of iron and copper, two-thirds the weight of aluminum.

While most applications of magnesium alloys to the automotive and aircraft industries are based on the appreciable weight-saving their use makes possible, other important properties include high strength and excellent machinability. Today, alloys of magnesium are available for casting, rolling, extrusion, and forging, and are generally classified according to suitability for casting or working. Several physical constants characteristic of pure magnesium afford a basis for comparison with other commonly used metals:

Mean specific heat (minus 17 deg. to plus 100 deg. C.)	= 0.2495
Melting point	= 651 deg. C
Average coefficient of linear expansion	= 0.000026
Thermal conductivity	= 0.376
Electrical conductivity	= 38.6 per cent

Magnesium alloys can be heat treated when the per cent of alloying constituents is more than about 6.5. The heat treating procedure involves subjecting the alloy to high temperature for a period of time sufficient to permit the intermetallic compounds to pass into solid solution. Properties of the solution heat-treated alloys can be further changed by exposing them to a temperature of approximately 350 deg. Fahr. for an additional time period. The latter processing is termed "aging" and what actually takes place metallurgically is that the solute constituents are precipitated to a predetermined amount. Results effected by these two heat treating methods are, generally, improvement of tensile strength and percentage elongation by the solution heat treatment, increase in yield strength and hardness by the precipitation heat treatment. In the latter process, the percentage elongation is reduced.

For casting, magnesium alloys have mechanical properties similar to those of aluminum. It is not always possible, however, to take full advantage of the difference in densities of the two metals and in practice the weight saving ranges between 28 and 33 per cent. Several reasons account for this: inasmuch as magnesium casting alloys are not so fluid as those of aluminum, the section may have to be increased for light wall castings. Where it is necessary to compensate for the lower strength modulus of magnesium, thickness of the metal section may have to be further increased. In order to avoid local stress concentrations, large fillets are sometimes made on corners and bosses, and beads are designed around cored holes and along the edges of ribs and webs. Most of these design considerations requiring additions of metal apply only to magnesium alloy castings which are to be subjected to high stresses. Usually, the pattern equipment originally intended for manufacture of aluminum castings need not be changed in any way for production of magnesium alloy castings.

In sand casting magnesium alloys some special equipment and slightly different molding and pouring methods are required. For castings of moderate size, a shrinkage factor of approximately 5/32 in. per foot is used, while on large castings where free shrinkage is prevented by bosses or internal cores, a shrinkage factor of about ⅛ in. is considered desirable.

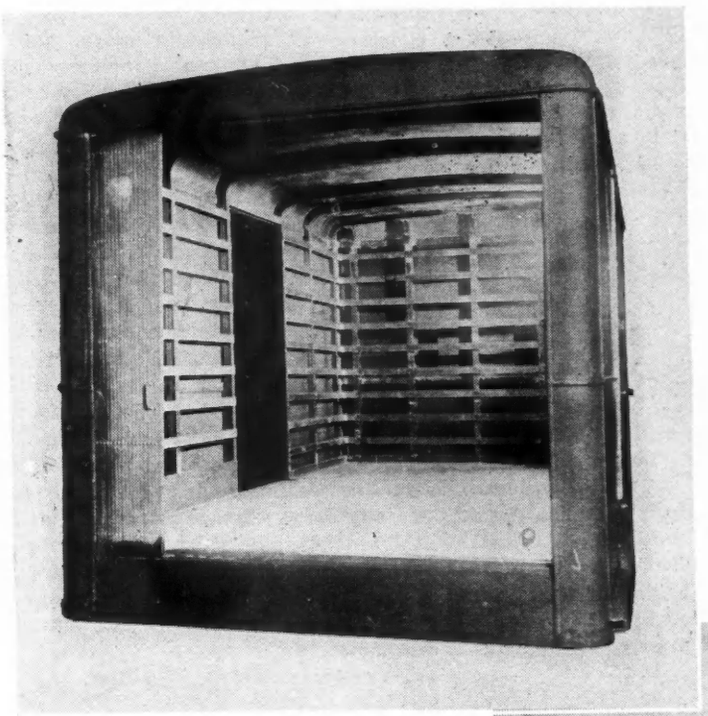
If produced in sufficient quantities, magnesium die castings are cheaper than sand castings. Some of the ad-

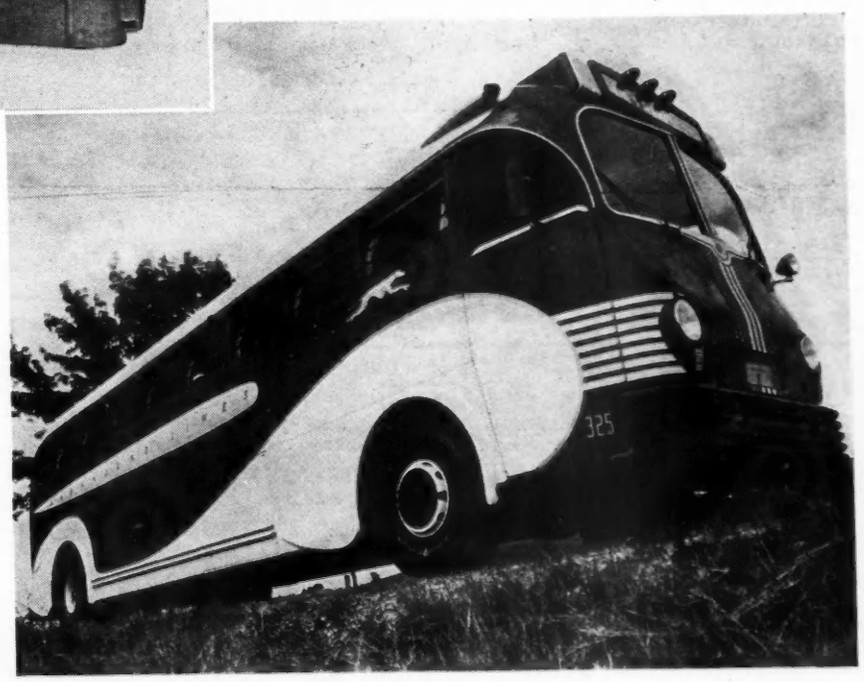
vantages accruing from die casting are: improvement in surface finish, less machining, better dimensional accuracy, and saving of metal by casting in thinner sections. Magnesium alloy forgings can also be made and press forgings are recommended wherever possible in preference to hammer forgings. Present forging practice entails a reduction in cross section of at least 50 per cent in order to obtain the maximum property improvement. Properties of most wrought magnesium alloys are not improved by heat treatment and depend solely on the percentage of alloying constituents and the plastic flow of metal either with or without accompanying strain hardening. Sections such as bars, rods, angles, channels, beams, and tubing are generally made from an alloy with good extrusion characteristics.

The magnesium alloys are also available rolled into plate, strip, or sheet. The rolled magnesium alloy sheet can now be made in a thickness of 0.005 in. Best temperatures for working have been determined as within the range between 400 to 800 deg. Fahr. Within this temperature range the maximum malleability is obtained. Cold working is possible in limited amounts on previously worked and recrystallized magnesium alloys. Magnesium hardens rapidly when it is subjected to very small amounts of cold working. While magnesium alloys are not as readily cold worked and formed as those of aluminum, it has been found that they form quite easily at about 550 deg. Fahr. Better results are obtained by slow forming than by rapid deformation.

Where magnesium alloys are substituted for malleable iron, sections must be increased sufficiently to provide strengths equivalent to the original casting. Notwithstanding the addition of metal, appreciable weight reduction is frequently achieved as illustrated by a recent case in which a magnesium alloy rear axle truck casting replaced one of malleable iron. The original casting weighed 375 lb.; the magnesium alloy casting, 176 lb., a saving of more than one-half of the original weight.

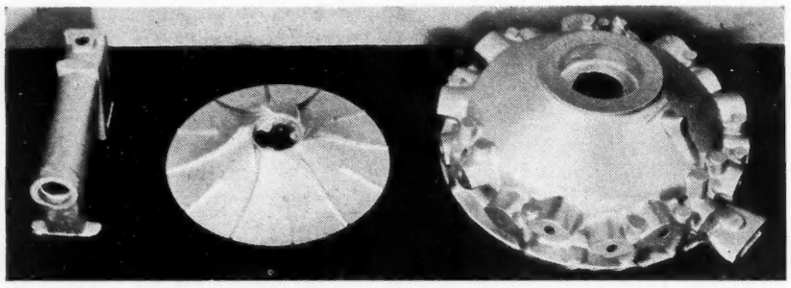
The ease with which magnesium alloys can be machined cannot be matched by any other commercial metal and it is possible to cut them at high rates of feed and speed. While the identical tools used for machining aluminum alloys may be employed in working on those of magnesium, it has been found more economical to use tools of slightly different design for the latter purpose. Tools for machining magnesium most economically are characterized by smooth tool faces, large peripheral clearances, ample chip space between cutting teeth, and small rake angles. The magnesium alloys can be machined dry with the correct type of tools, and ignition of chips is readily avoided when proper machining methods are used. *(Next page, please)*





(Above) Freight truck body of magnesium alloy. Weight, 1300 lb.; pay load capacity, 10 tons

(Right) Decrease in deadweight resulting from aluminum alloy construction has greatly increased efficiencies of many types of buses. Pictured here is a modern streamlined bus of the Greyhound lines



Magnesium alloy cast parts for the Lycoming aircraft engine

Savings of 20 to 40 per cent in machining time can be obtained with magnesium castings as compared to aluminum if equipment used is capable of attaining a peripheral speed of at least 3000 ft. per min. Naturally, the economy of machining is even greater when malleable iron or steel castings are replaced by magnesium alloy. Roughly, machining of magnesium is accomplished three times as quickly as cast iron.

Under ordinary atmospheric conditions, magnesium alloys are very stable and the metal surface requires no protection. However, salt solutions will corrode the surface metal and protection must be provided in applications where a destructive influence of this character will be encountered. The chrome-pickle or acid-dichromate is one of a number of protective coatings which have been developed and, in addition to the protection it affords, it makes an excellent base for paint. The method consists of placing the part in a bath of sodium dichromate and nitric acid. An alternative process, termed the chrome-phosphate treatment, utilizes a solution of sodium dichromate and sodium dihydrogen phosphate. The disadvantage of the latter is that it requires a longer immersion period than the acid-dichromate process. It is generally considered best practice to cover all magnesium alloy parts with dichromate coating along with primer and paint.

A great deal of experimental work has been done in recent years to improve primer and finish paint coatings for magnesium alloys. Before shipment by the manufacturer, magnesium castings, extrusions, and sheets are given a dichromate coating (otherwise known as chrome-pickle). After machining it is considered best practice to free all metal surfaces from dirt, oil or grease. For this purpose a good alkali cleaner is satisfactory and is especially effective when applied hot. Dichromate coating is applied to any surfaces from which it may have been removed during the forming operations; Naval aircraft anodic coating is recommended particularly for coating machined surfaces. The zinc chromate type of primer coat is considered preferable. Finally, the finish paint coats are applied and, where the metal surface will only be subjected to indoor exposure, any kind of paint over an adherent primer of the zinc chromate type is said to be adequate.

For most applications in the automotive and aircraft fields, finish coats of oil-base synthetic resin enamels of the glycerol phthalate or of the phenolic type are recommended. It is also reported that high-grade spar varnishes when mixed with aluminum paint pigment are entirely satisfactory. Where the magnesium alloy part will be subjected to severe exposure conditions, it is suggested by a reliable source that each coat of primer and finish be given a one-hour bake at 250 deg. Fahr. This improves adhesion and resistance to moisture penetration.

Introduction of small amounts of manganese has improved the corrosion resistance of magnesium alloys. Only about 0.3 to 0.5 per cent manganese can be alloyed with a magnesium alloy containing approximately 4 to 8 per cent aluminum, but this is sufficient to appreciably inhibit corrosion. It is sometimes desirable to protect the metal surface with a clear finish. Either lacquer or varnish type coatings are suited for this purpose, providing they are distensible and resistant to sunlight.

Most of the welding developments recounted for aluminum in this article apply to current practice for fabricating magnesium alloys. The standard equipment available is suitable for making electric spot and seam welds. For acetylene welding a flux, composed essentially of sodium, potassium, and lithium chlorides, must be used. Apparently, superior results are obtained with a fused and ground flux. Strength of welds is fully equal to that of the cast metal.

Automotive *Materials* NEW DEVELOPMENTS

Electrode for Flat Welding Deep-Groove Joints in Mild Steel

An arc welding electrode designed especially for flat welding of deep-groove joints in mild steel has been developed by the Lincoln Electric Co., Cleveland, Ohio. When proper welding technique is used, the new electrode—designated as Fleetweld 9—is said to overcome certain conditions frequently encountered in deep-groove welding which tend to cause formation of surface holes in the metal.

All weld metal specimens of Fleetweld 9 have tensile properties as follows (varying somewhat with composition of the plate, heat of welding, capacity of plate and size of electrode used): tensile strength of the metal as welded, 66,000 to 74,000 lb. per sq. in.; yield point, 50,000 to 60,000 lb. per sq. in.; ductility, elongation in two inches, 20 to 30 per cent.

When stress relieved at 1200 deg.

Fahr., the weld metal properties are: tensile strength 64,000 to 72,000 lb. per sq. in.; yield point 45,000 to 55,000 lb. per sq. in.; ductility, elongation in two inches, 25 to 40 per cent.

Average tensile properties of stress relieved Fleetweld 9 weld metal, taken from 1½-in. plate welded with ¼ in. using 340 amp., A. C., are: tensile strength, 68,000 lb. per sq. in.; yield point 53,000 lb. per sq. in.; ductility, elongation in two inches, 33 per cent.

On free bend test, a specimen of the metal is reported as showing 78 per cent elongation in outer fibers. Other physical properties of the new electrode weld metal are: specific gravity 7.85 to 7.86 gm. per c.c.; impact resistance 30 to 60 ft.-lb. (Izod) and endurance limit 29,000 to 34,000 lb. per sq. in.

Fleetweld 9 is designed to operate with either A.C. or D.C. The electrode is made in three sizes, 3/16 in., ¼ in., and 5/16 in.

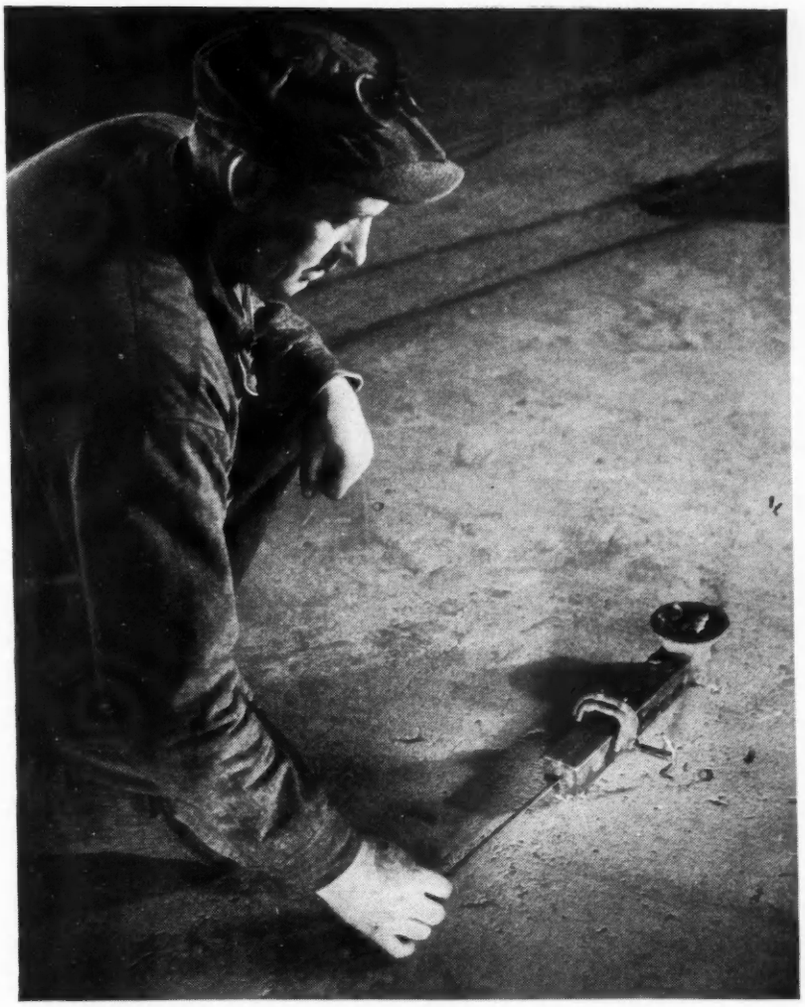
New Alloy Cast Iron Has Tensile Strength of 66,000 lb. per sq. in.

A new alloy cast iron has been introduced on the British market under the trade name Ni-Tensyl. In the manufacture of this product a start is made with cast iron of low carbon content, to which from 1.5 to 2.0 per cent of nickel and from 1.25 to 1.75 per cent of silicon is added by means of a special process. In the final product the graphite is very finely dispersed.

This high-test cast iron ordinarily shows a tensile strength of 56,000 lb. per sq. in. and this may be increased to 66,000 lb. per sq. in. by a simple quenching and tempering process. The hardness may be as high as 280 Brinell, yet this new material machines as well as ordinary cast iron. It also has higher shock resistance and resistance to abrasion. It has been offered as a substitute for cast steel for high-speed flywheels.

Method of Determining Composition and Consistency of Slag

Careful control of composition and consistency of slag, a major factor in basic open-hearth steel making, has been brought to a high degree of perfection by the VisControl method recently developed by the research, metallurgical, and open hearth staffs of Bethlehem Steel Co. Slag formed in the open-hearth furnace plays an important part in the purification of the steel and correct relation between basicity, iron oxide content, and viscosity of the slag is essential to efficient operation.



Determining slag viscosity by the VisControl method. The operator has poured liquid slag into the well at the end of the instrument and is measuring the distance the slag flows into the ¼-in. hole in the rectangular block

As described by C. H. Herty, Jr., Development and Research Department of the Bethlehem Steel Co., the instrument used for measuring slag viscosity consists of a rectangular steel block with a well at one end, and with a ¼-in. hole extending from the well to the other end, a distance of 10 in. A sample of slag is dumped into the well as quickly as possible. Before it has time to solidify, it flows into the hole and the distance which it flows is a measure of the fluidity of the slag. A heavy, viscous slag will flow a maximum of 2 in., a creamy slag 2 to 4 in., and a thin slag 4 to 10 in. Viscosity tests are taken at half-hour intervals during the early part of the heat.

These tests, and analyses of metal and slag, are referred to a schedule which gives the required basic or acid additions. Uniformity obtainable by the method is illustrated by slag analyses from four different Bethlehem plants, all producing low carbon rimmed steel. In spite of wide variations in raw materials, the average yearly FeO content of the slag was 22.7, 21.9, 21.9, and 21.6 per cent, respectively.

Important function of VisControl is to maintain the lowest FeO content in the slag that will give satisfactory removal of phosphorus and sulfur. This is of especial interest in subsequent deoxidation of the steel, as accurate control of oxidation in the furnace fixes—within narrow limits—the amount of deoxidizer used to finish the heat. This has direct influence on many characteristics of the steel, such as cleanliness, ductility, and deep-drawing qualities.

Reoxidation of the steel by slag is also minimized, and it becomes easy to maintain constant ladle conditions during the entire teeming period, so that the last ingots show little or no difference in analysis and physical proper-

ties from the first ingots of the heat. With very fluid, highly oxidizing slag, on the other hand, it is often difficult to arrive at the proper carbon and manganese content, particularly with steels that are not dead killed in the furnace.

Degree of oxidation of metal and slag has also a marked effect on the aluminum added in the ladle to control grain size of the steel. With VisControl it is reported to be easier to obtain the exact grain size desired.

New Anodic Process for Coating Magnesium Alloy Parts

An anodic process for protecting magnesium alloy parts against corrosion was recently perfected by R. W. Buzzard and J. H. Wilson of the National Bureau of Standards. In addition to high corrosion resistance imparted by the new method to alloys of magnesium, it is said to furnish an adhesive base for primers and paints equivalent to that provided by chrome pickel. Further, cross sections of light metal alloy parts are not appreciably reduced.

Before being anodized by this method, a part is cleaned in an electrolytic bath of sodium carbonate and trisodium phosphate. The alloy piece is then made the anode in a bath containing 10 per cent sodium dichromate and 2 to 5 per cent monosodium phosphate.

The anodic film can be applied over a wide range of current densities and temperatures. Experimentation has shown, however, the most satisfactory results to be obtained with 5 to 10 amp. per sq. ft. at 120 deg. Fahr.

Instrument Measures Thickness of Nickel Coatings by Magnetic Method

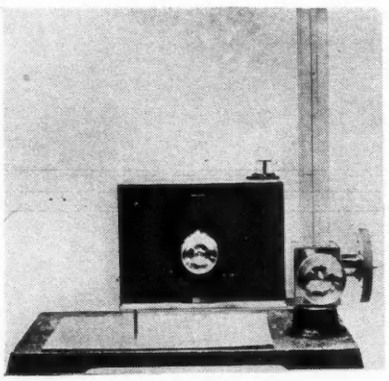
Local thickness of nickel coatings electroplated on a non-magnetic base metal may be measured by a new instrument recently brought out by the American Instrument Co., Silver Spring, Md.

Principle of the method involves measurement of the force required to detach one pole of a permanent magnet from the nickel coating and comparison of this force with that required to detach the same magnet from a similar nickel coating of known thickness deposited under approximately the same conditions as the coatings to be tested.

Nickel coatings deposited under different conditions have somewhat different magnetic permeabilities. If such coatings are annealed at 750 deg. Fahr. they acquire about the same permeability. Therefore, the magnetic method is more reliable for annealed coatings than for coatings as deposited. Measurements on coatings as deposited are correct within 15 per cent, and on annealed coatings within 10 per cent.

The magnetic method is rapid and non-destructive, and for thin coatings its accuracy is reported to approach that of metallographic measurements. The metallographic method (in which thickness of coating is measured by means of microscope and scale) requires experience and expensive equipment, results in destruction of the specimen tested.

Sensitivity of the instrument can be varied by selection of the spring, each division on the dial corresponding to approximately 0.00001 in. of nickel, so that 100 divisions cover the range of thickness usually applied to non-ferrous metals. Reproducibility is approximately 3 per cent on coatings down to about 0.00002 in.



American Instrument Co. device for measuring local thickness of nickel coatings

The new instrument is said to be equally applicable to plane, convex, and concave surfaces. Presence of the usual thin chromium coatings over the nickel has no appreciable effect on thickness measurements, and is advantageous because it prevents oxidation of nickel during annealing.

"Spotting Out" Defect Appearing on Plated or Oxidized Metal Products Discussed

"Spotting Out," a defect that appears on plated or oxidized metal products, was discussed by Gustave Klinkenstein, Maas & Waldstein Co., Newark, N. J., at the annual convention of the American Electro-Platers' Society.

It was pointed out that there are two kinds of "spotting out." First of these, called crystal spotting, occurs only on oxidized products; products of brass, copper, silver, nickel, and other metals (either solid or plated) with the surface darkened by treatment with sulphide solutions. The other kind of spotting is called stain spotting, and occurs chiefly on plated products.

Crystal spots form on oxidized products after they have been lacquered. They are usually small, dark in color, and obviously crystalline when viewed under a lens. They are due, it is said, to action of sulphur on the metallic sulphide coating of the product. Crystal spotting is minimized by using sulphur-free wrappings and by protecting products from atmospheric sulphur by using lacquers specially developed for the purpose.

Stain spotting is caused by traces of salts from the plating bath (chiefly cyanides) which remain in the pores of the metal, according to Mr. Klinkenstein. These residual salts cannot be completely removed by rinsing and, unless their action is neutralized in some way, they will absorb moisture, overflow the pores, and form blotches on the surface of the product.

To reduce stain spotting, the following precautions were recommended: use compact base metal; keep free cyanide in bath low; thorough rinsing; allow products to stand over night in humid atmosphere after plating and remove stains next day; bake products at 250 deg. Fahr. to inactivate the salts; use "non-stain-spot" lacquers.

Carboloy Cone-Shaped Tips for Lathe and Grinder Centers

Carboloy Co., Inc., manufacturers of cemented carbide tools, dies, and wheel dressers, reports that lathe and grinder centers—on which Carboloy cone-shaped tips are substituted for ordinary steel tips—wear 50 times longer than ordinary centers.

In a recent test using No. 72 steel shot at 100 lb. pressure, a bar of Carboloy ⅜ in. square was blasted for 40 min. At the end of the period it showed no appreciable wear although its surface finish was slightly dulled. A bar of steel the same size, having 65 Rockwell "C" hardness, was blasted for the same period. At the end of 40 min. 50 per cent of its area at the point of blast had worn away.

Because of diamond-like hardness, cemented carbides resist extreme wear on lathe and grinder centers, particu-

(Turn to page 102, please)

Just Among Ourselves

Slay It With Telegrams

ONCE upon a time the future free existence of the automobile industry hung upon the decision of a Federal Circuit Court, one step removed from the Supreme Court of the United States. In the past 25 years the Selden Patent decision has passed into history as a *cause celebre* which left its mark on American jurisprudence as an example of the exacting research, the painstaking care, and the magnitude of testimony necessary to the production of a decision in equity by even the best qualified judges.

Would litigants and defendants in the Selden Case have poured hundreds of thousands of dollars into the patient collection of testimony, the preparation of interminable briefs and oral argument if it had been believed beforehand that the court to hear the case was hand picked for its opinions rather than its ability to weigh facts and justice?

THE law insists that both parties to a suit come into court with clean hands. Legal ethics in any court worthy of the name have always been overwhelmingly insistent on a judge stepping aside if he had any previous interest with either of the parties to a suit. If such standards are not preserved, so far as any standards can be preserved in this fallible world, there are no courts of justice, only men sitting on a bench.

That the Federal Courts should be, as far as possible, staffed by men who can subordinate personal opinions to the body of the law, is an axiom which most Americans accept without question. That the desirable condition has been achieved on the whole is demonstrated by the fact that impeachments of Federal judges, since the establishment of the Federal Constitution, have been negligible in number and importance.

MEDALS like these are being distributed to former sit-downers by the International Union, United Automobile Workers of America. The medals read: "honor award for winning sitdown strike." Viewed otherwise they are "honor" awards for illegal occupation and property damage, and, therefore, an affront to the laws of the United States.

ONCE the integrity of a Federal Court meant everything to the future of the automobile industry. We believe today that it means everything to the automobile industry as it does to the people as a whole.

The future of labor relations, of wages and hours, of the government control of industry; even of the way automobiles are sold, will rest eventually on judicial decisions arising out of governmental attempts to extend the field of government into business.

If political rather than judicial experience qualifies future appointees to the Supreme Court, that body becomes no longer a court but a Star Chamber which exists to confirm and enforce the acts of the legislative. All legal practice would tend to become special pleading; all decisions of the court could be written in advance except for the specious reasoning which would be used to justify decisions.

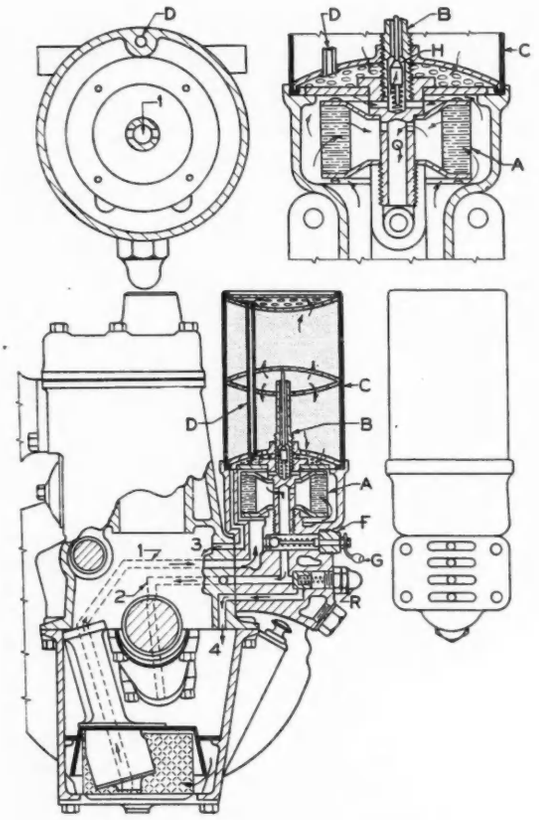
IN the lowest courts in the United States, honest efforts are made to preserve members of the jury from being influenced by emotion and other factors nor pertinent to an unbiased decision. What a farce it would be if the judges of the highest court were to be appointed in the first place for their opinions, to the point where a particular body of opinion dominated all decisions of the court.

An important decision affecting the future of the industry and of the nation is in the hands of a few heat-beset Senators in Washington. To some of them the Supreme Court Bill is just another political measure to be settled on political grounds and "then we can go home." The human wish to "get away from it all" will tend toward compromise on the bill, in spite of its fundamental importance.

THERE are other Senators who recognize that something more important than a political measure is in the wind, and that compromise on the bill is in itself a betrayal of trust. Some Senators seem honestly in doubt as to the course they should take.

In the next week or two there is opportunity for every industrial executive to express his opinion to his Senator, by telegram and letter, in opposition to a hasty meddling with the Supreme Court. Prompt action is imperative to stifle the compromise tendency.—H.H.

Full-Flow, Two Stage Oil Filter



Winslow full-flow, two-stage oil filter.

AN improved type of oil filter, adapted for full-flow filtration, was described to the S.A.E. Northern California Section by Chas. A. Winslow of Oakland recently.

First the oil passes through a relatively coarse screen over the pump inlet. It then passes up through the pump and is forced into the filter base and settling sump. Here its velocity is greatly reduced, and the oil next passes through a filter element of sufficiently-fine mesh so that anything that will pass through it will also readily pass through the bearing clearances. Next follows a secondary stage of filtration in which the finer grit is trapped in an absorption-type filter. In other words, primary filtration is accomplished by a metallic element of very fine mesh, while secondary filtration is accomplished by a cotton-waste absorption-type element.

Referring to the sectional drawing, the base of the filter has four openings in the pad. Oil enters at *1*, at a pressure which is governed by the pressure-regulating valve *R* (say, 40 lb. per sq. in.). On its way from the inlet to the outlet the oil is compelled to pass through the filter element *A*. It is claimed that, owing to the relatively large area of the filtering element and the low velocity in the filter sump, there is no pressure drop between *1* and *2*.

A portion of the oil passes up over the element *A*, into tube *B* and the quick-detachable container *C*, which constitutes the interchangeable absorption-type filter element. The outlet *D* from the removable element *C* passes down through the base casting and connects to the engine crankcase at *3*. It should be noted that the pressure-regulating valve *R* is behind the primary filter element *A*, hence it exercises a definite control over the lubricating oil pressure and at the same time permits the filtering element *A* to be a high-pressure, positive filter. A safety valve *F* is provided to prevent damage to either the pump or the filter as a result of the oil getting too cold and viscous. A buzzer or light may be connected to the valve at *G* to give warning of its operation.

The lower right-hand view is an outline drawing of the oil filter and shows the mounting pad. This will be seen to have four openings. Oil flows into the filter at *1* (left-hand drawing), primarily-filtered oil passes out to the bearings at *2*, the absorption-type filter discharges into the crankcase at *3*, and the pressure-regulating valve discharges into the crankcase at *4*.

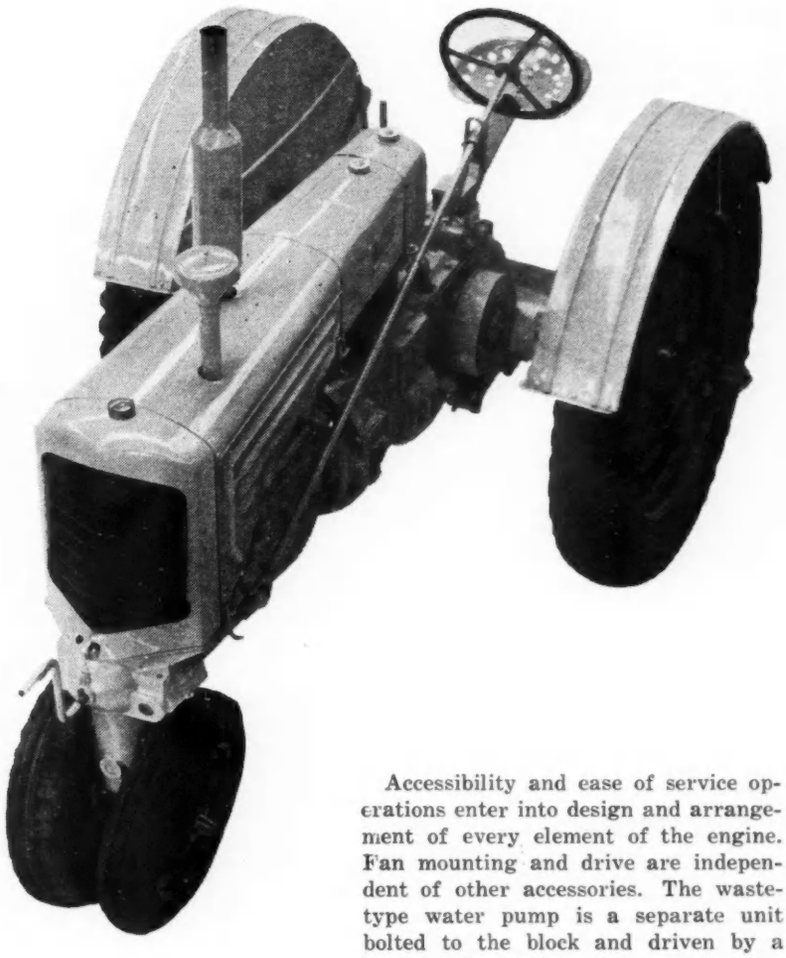
The upper left-hand view illustrates the relation of the mounting flange to the body of the filter, while the upper right-hand view illustrates the relation of the primary filter element *A* to the secondary filter element *C* and also the oil passages up and over the element *A* through the central drilled fitting up around the check valve *H* and through tube *B*. When the secondary filter element *C* is properly installed and firmly seated on the base casting, it holds the delivery check valve *H*, open, allowing oil to pass from the pressure-tight chamber of filter element *A* into the secondary-element casing *C*. In operation, both of the filtering elements can operate at full oil pressure. However, the maximum pressure difference on element *A* is always governed by the safety valve *F*.

In the case of the secondary element *C*, the full engine pressure is exerted in an expansion chamber in the center of the element, uniformly against a layer of absorption material 4 in. thick. This design eliminates pressure on the head of the can and on the gasket surface where the can attaches to the base casting, as the outlet is vented to the crankcase through passages *D* and outlet *3*.

Can *C* can be changed without loss of oil while the engine is in operation. Should it come loose or be knocked off accidentally, no oil will be lost from the crankcase, because, as previously stated, the can must be properly in place to hold the delivery check valve *H* open.

Advantages claimed for the filter are: Complete bearing protection and clean, acid-free oil at all times; the filter element can be changed quickly at low cost and without soiling of hands.

New Tractor Engine of Unusual Design



Model Z Minneapolis-Moline tractor with new type "RE" engine. Note clean lines, complete visibility for operator, and ample ground clearance so necessary for general farm service. The tractor is fitted with automotive type brakes, one of which may be seen on the right at the rear.

Novelty is conspicuous in the disposition of combustion chamber and valves in a horizontal plane.

THE new "RE" engine used in the model Z tractor just placed on the market by the Minneapolis-Moline Power Implement Co., possesses many unique features and is perhaps the only engine of its type in production in the United States. Essential specifications of the four cylinder unit include 3⅝ in. bore by 4½ in. stroke, 185.7 cu. in. displacement and a top speed of 1500 r.p.m. Sectional drawings of the engine are reproduced in this issue on pages 95 and 96. It will be noted from examination of the transverse sectional view that novelty of design lies in the disposition of combustion chamber and valves in the horizontal plane. Valve gearing has been greatly simplified through unconventional means. As the drawing indicates, valves are actuated by long rocker arms contacting the camshaft and valve ends at their extremities without the use of push rods or special lifters.

Cylinders are cast in pairs, of semi-steel metal, and are readily removable. Rocker arms also are fitted in pairs for each cylinder, being mounted in easily removable brackets provided with plain bearings. The crankshaft is a very heavy heat-treated drop forging of SAE 1045 steel and is mounted on two anti-friction ball bearings: front, BCA No. 313; rear, BCA No. 314 double-shielded.

The engine is designed to operate efficiently on either gasoline or distillate. Compression ratio may be varied to suit the fuel. Standard compression ratio is 4.5 to 1 but heads are available for compression ratios up to 5.75 to 1. Carburetor is Schebler 1 in. updraft. Spark plugs are 18 mm. Champion. Valve seat inserts are provided for the exhaust ports.

Accessibility and ease of service operations enter into design and arrangement of every element of the engine. Fan mounting and drive are independent of other accessories. The waste-type water pump is a separate unit bolted to the block and driven by a V-belt. The oil filter is mounted externally in a recess in the crankcase and bolted directly to the oil pump; the latter is also externally mounted for quick accessibility. The arrangement produces a close-coupled and self-contained oil system with no plumbing of the usual type.

The crankshaft is mounted on two ball-bearings with the rear bearing carried in a large retainer, making it possible to remove shaft and bearings through the bell housing. The flywheel is attached to the shaft on a taper spline. The camshaft is of cast alloy iron—Proferal metal—made by Campbell-Wyant, and Cannon.

The crankcase serves as an integral part of the back-bone of the frameless chassis. It is a one-piece casting of gray iron, of heavy section and ribbed to provide rigidity.

Valve adjustment is readily made through the valve cover plates. Connecting rods and bearings, camshaft, etc., may be reached through the large cover plates on the side of the crankshaft case. The connecting rod bearing cap joint is split at a convenient angle so as to make it possible to replace the precision bearings through the cover plate. Maintenance work on the piston assembly is handled by removing cylinder blocks.

The carburetor may be dropped by

Minneapolis-Moline "RE" Engine Specifications

Bore and stroke	3⅝ in. by 4½ in.
No. cylinders	Four
Compression ratio	Std., 4.5 to 1; available up to 5.75 to 1
N.A.C.C. horsepower	21
Piston displacement	185.7 cu. in.
Rotation	Clockwise from crank end
R.P.M. maximum	1500
Cylinders	
Material	Semi-steel
Cast	In pairs—removable
Crankshaft	
Material	S.A.E. 1045 heat treated drop forging
No. of main bearings	Two
Type	Anti-friction ball bearing
Size	Front No. 313. Rear No. 314 double shielded bearing
Connecting rod	
Material	S.A.E. 4040 heat treated drop forging
Bearing size	2⅝ in. diameter by 1 9/32 in. long
Bearing type	Steel backed Babbitt lined shell
Center to center	9 in.
Pin bearing	1 in. diameter by 1½ in. long No. 444 bronze
Piston	
Material	Cast iron
Compression ring	Three ⅛ in. wide
Type	Plain
Oil control ring	One 3/16 in. wide
Type	Double scraper ported
Piston pin	
Type	Full floating
Diameter	1 in.
Camshaft	
Material	Cast (Proferal Metal)
Method of drive	Helical gears
Location	Right hand side from crank end
Valves	
Arrangement	Side valves (Horizontal in block)
Exhaust—size	1¼ in. diameter
Material	No. 1 Silicrome
Inserts	Yes
Intake—size	1¼ in. diameter
Material	S.A.E. 3140
Inserts	No
Oiling system	
Type	Force feed to connecting rods, valves, accessory drive and governor
Filter	Waste type
Oil pump	Submerged gear type
Capacity	6 gal. per min.
Oil capacity	7 qts.
Water pump	
Type	Centrifugal
Drive	"V" belt
Capacity	28 gal. per min.
General	
Fan	16 in. diameter, 4 blade
Ignition	Fairbanks-Morse magneto; high tension impulse coupling
Spark plugs	18 mm. Champion
Carburetor	Schebler—S.A.E. 1 in. flange
Starting motor	Optional
Generator	Optional
Crankcase ventilation	Self-cleaning breather
Combustion chamber cover	Removable
Flywheel	For 10 in. gear type clutch
Governor	Enclosed variable speed
Fuels	Gasoline and Distillate
Bell housing	S.A.E. No. 4
Weight (complete)	660 lb.

removing two studs. The combustion chamber cover is removable and facilitates carbon and valve operations, including valve replacement.

The sectional view on page 96 shows the centrifugal drive off the camshaft gear. The governor is inter-connected with the throttle and produces a variable speed control depending upon the throttle opening. As shown, the governor may be removed entirely for examination or maintenance. The drawing also shows the detail of the crankshaft center bearing which is in reality a loosely-fitted oil sleeve. Its function is to deliver full-pressure oil feed into the crankshaft.

The oil pump is driven by a long vertical shaft, geared from the camshaft at its extremity in the timing gear case. The upper end of the accessory drive shaft drives the high-tension Fairbanks-Morse magneto through an impulse coupling which greatly facilitates hand starting.

Pistons are of cast iron with three plain compression rings and one oil control ring of double-scraper-ported type. Connecting rod bearings are steel-backed babbitt precision liners.

Lubricating system is force feed to connecting rods, valves, accessory drive, and governor. As mentioned earlier, the pressure line to the crankshaft enters through the center oil sleeve.

The cooling system has been laid out generously to provide ample water jackets around the cylinder bores, valves, cylinder head, and spark plugs.

The engine has been completely sealed and protected by felt dust seals at the bearings, breather, and dip stick, and by provision of a wetted type air filter for carburetor intake.

Progress in Traffic Control Systems

SPEED with safety on highways requires adequate traffic control as well as adequate lighting. In this field marked progress has been made, as traffic control signal systems have evolved from the familiar regimented "On" and "Off" of all lights on a street to the flexible progressive system with several complete changes of timing and reset each day, and adjustable splitting of the time intervals in each cycle between through and cross traffic. The basic thought in modern traffic control is to tell the driver at all times what he is to do *next*, not merely what he should do *now*. Thus, the short amber signal before the green tells him to get ready to start, and the flashing green before the amber tells him to speed up to avoid a red light at the next intersection. Six months' operating records of traffic with the latest type of control show 30 per cent greater traffic speed and 46 per cent fewer accidents.—From John Liston's review of electrical progress during 1936.

Minneapolis-Moline Tractor Engine Model RE

This four-cylinder engine has a bore of 3⅝ and a stroke of 4½ in., making its displacement 185.7 cu. in. A novel feature is the arrangement of the valves in the cylinder heads in such a way that the heads can be cast integral with the block, yet the valves can be readily removed after a water-cooled cover plate has been taken off. The location of the valve chamber over to one side of the cylinder naturally results in effective cooling of the last portion of the charge to burn, thus suppressing detonation. A centrifugal governor is built into the engine and is set to hold the engine speed to 1500 r.p.m. The engine can be operated on either gasoline or distillate, its standard compression ration being 4.5 to 1, but a special head with a compression ratio of 5.75 to 1 is also available.

The crankshaft is of the four-throw, two-bearing type and is supported in two large ball bearings. Nevertheless, the connecting-rod bearings have force-feed lubrication, the

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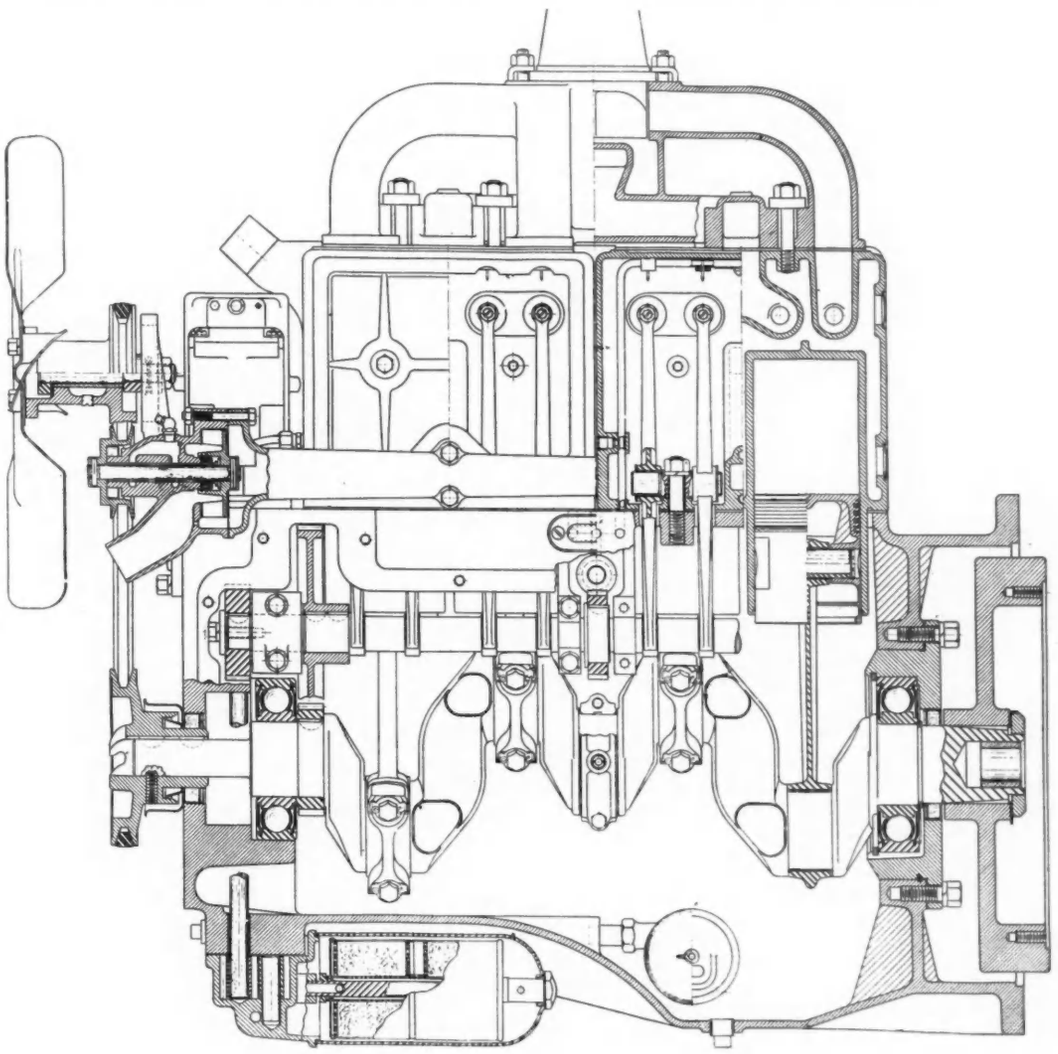
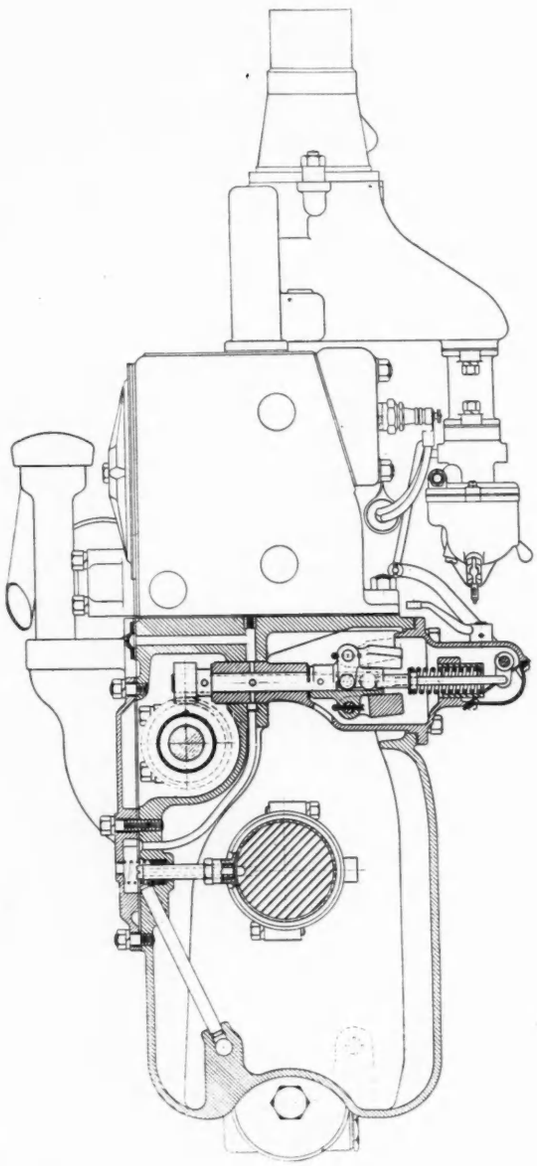
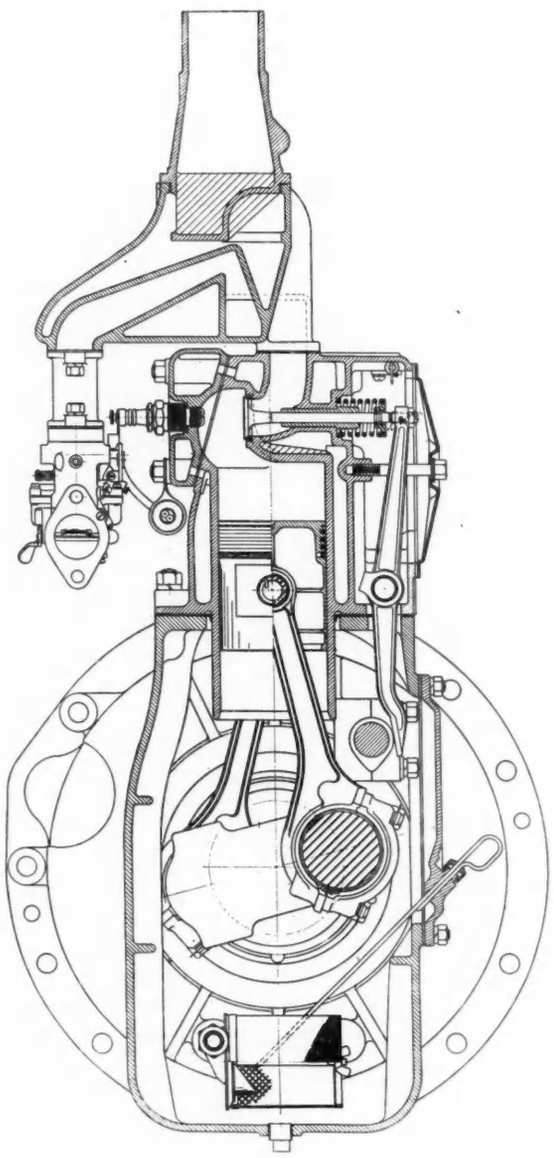


No. 34 in the AUTOMOTIVE INDUSTRIES Series of Engineering Drawings

Minneapolis-Moline Tractor Engine Model RE



(Continued from preceding page)
oil entering the drilled crankshaft through a dummy bearing on the central journal. The valves are actuated through long rocker levers directly from the camshaft, which is driven through spur gears mounted inside the end bearings of the crankshaft and camshaft respectively. It will be noticed that the cylinder block is cast separate from the crankcase, which latter is in a single casting, the crankshaft being introduced through a large opening at the rear end. Connecting-rod heads are split at an angle, so the caps can be more easily removed through a side opening in the crankcase. Valve-clearance adjustment is by means of set screws in the upper end of the long rocker levers, which are quite accessible after the valve cover plate has been removed.



Production Lines

Lowering and settling a body onto a chassis on the Pontiac final assembly line. With the body in place, the cradle is unhooked and hauled up the drop for the next body.

Instrumentation

A recent visit to Pennsylvania State College engineering experiment station opened our eyes to the fact that Schweitzer and DeJuhasz are completely surrounded by the most astounding array of specialized instrumentation that we have been privileged to witness. Out of this laboratory come some of the most advanced studies on diesel engine mechanics and combustion process—nozzle characteristics and behavior, diesel fuel rating, etc. It's done with mirrors in optical indicating instruments, with cathode ray apparatus of a type hitherto unknown in the U. S., mechanical indicators, and the like. They are learning many interesting things about spray nozzles and are developing methods which make it possible to adjust the variable controllable elements of the fuel injection system so as to yield the best results for any given engine.

New Ceramics

It is well known that aircraft engines are reaching for the very ultimate in bhp. per lb. of engine weight and are approaching the ideal conditions by many refinements and changes in combustion chamber design and combustion control. This is paralleled by steadily increasing compression ratios with the utilization of high octane fuels. Right in this picture we find spark plug developments aiming at better performance and longer useful life. Recently we were shown some amazing developments in ceramic materials for aircraft plugs. We can't say much about this at the moment except to say that the process is simply breath-taking. The transformation changes in production are such as to be appreciated by the naked eye and, consequently, do not require an explanation of obscure scientific phenomena.

Clean Lubes

The past couple of years have been marked by the introduction of engine-oil filters of remarkable efficiency. AC has been the most recent entry with a filter which cleans the oil in a matter of a few hours of running. In these days such filters fill an important need on passenger car engines since they protect the bearings and other parts of the engine. From the car owners' point of view, the new type of filters are easier to service, reduce the frequency of engine lube draining, and aid in preventing the formation of sludge. At the moment such attachments probably are too expensive for factory installation but since many owners are willing to make their own installation, it might be a very good idea to provide space for such an installation on production jobs.

Protect Welders

Following current studies of occupational hazards, the Metropolitan Life Insurance Co., has just issued a booklet dealing with the "Health Protection of Welders." It lists and discusses in full, four principal hazards that are encountered—electric shock and burns; radiant energy; gases, fumes and dust; miscellaneous, including possible exhaustion of oxygen in the air in confined spaces. Those concerned with personnel problems will find this bulletin an invaluable source book bristling with practical hints as to the control of possible hazards.

Clad Cutting

July *Oxy-Acetylene Tips* has an interesting report on a new technique for torch-cutting stainless-clad sheets. Common practice has been to cut from the stainless side. And research has proved that it is more economical to reverse the process and cut from the mild steel side, holding the blow torch at a slight angle with respect to the vertical. Any one working with the stainless-clad materials will find it profitable to study the new technique.

Less Cost

Several days ago we were shown a unique clutch design embodying some new principles resulting in a reduction of mass and inertia loads. Compared with a certain conventional clutch, this unit mounts interchangeably but weighs less and is smaller in diameter. This clutch should break into the news some time in the near future.

Climb Milling

Master mechanic of a prominent parts plant told us recently that his shop was changing over to climb milling on all gear and spline-hobbing equipment. This will be recognized as a rather spectacular step despite the fact that climb-milling has been recognized for years. It is of interest to note that

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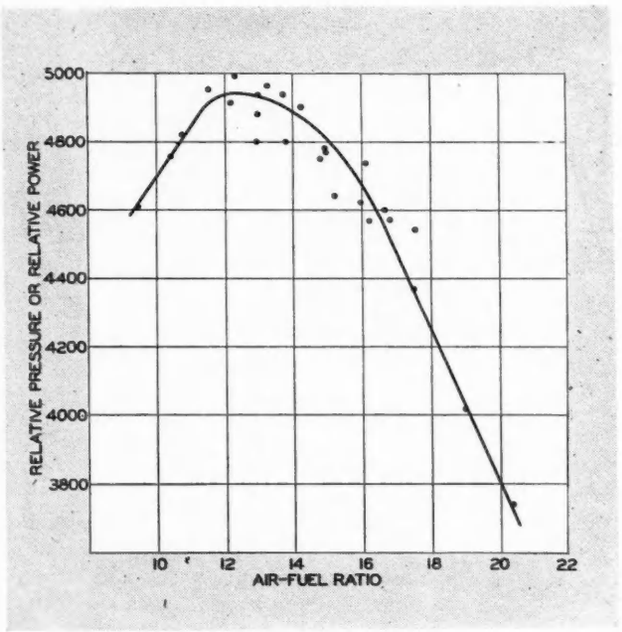


FUEL EFFICIENCY

Fig. 1 — "Theoretical" mixture-ratio is in close agreement with experimental observations

By CLARKE C. MINTER

SINCE the automotive engineer strives to obtain the maximum output from his engine at power loads, and to operate with a minimum fuel consumption at road loads, he is interested, in general, in only two mixture-ratios, namely, that giving maximum power and that giving maximum economy. A great deal of experimental evidence has established that, with a hydrocarbon fuel of about 85 per cent carbon, the air-fuel ratio for maximum power lies between 12 and 13, while the best fuel economy is obtained when the mixture-ratio is about 17 to 1.

There is nothing academic about these two mixture-ratios, since they have been observed to be the mixture ratios for maximum power and maximum economy. It is of interest to note, however, that these two mixture ratios are "theoretical" points and can be calculated very easily. It is also of interest to note that the calculated mixture-ratios for maximum power and for maximum fuel economy agree quite closely with those determined experimentally by many observers.

The only experimental data needed for the calculation of the two mixture-ratios are maximum explosion temperatures over a wide range of mixture-ratios. It is only recently that satisfactory measurements of maximum temperatures in an internal combustion engine have been made, and it is to be regretted that more data of this type are not available. However, for the present discussion we shall make use of the only temperature measurements covering a wide range of mixture ratios, namely, those of Hershey and Paton (Flame Temperatures in an Internal-Combustion Engine by Spectral Line Reversal, University of Illinois, Engineering Experiment Station Bulletin No. 262, 1933).

Table No. I

1 Air-Fuel Ratio *R*	2 Mols Combustion Products *N*	3 Maximum Combustion Temperature *Tm* °F. Abs.	4 Maximum Combustion Pressure *NXTm*	5 Relative Fuel Efficiency *RNTm*
15.20	107.12	4330	4640	7005
12.15	113.80	4315	4910	5970
12.09	113.95	4400	5010	6005
12.30	113.38	4400	4990	6140
14.92	107.34	4450	4780	7130
17.51	106.18	4270	4540	7930
10.76	118.30	4075	4820	5190
11.53	115.66	4275	4950	5710
13.70	109.90	4490	4935	6760
13.23	110.95	4470	4960	6550
13.79	109.70	4370	4800	6620
16.19	106.85	4280	4570	7400
14.80	107.60	4412	4750	7030
15.97	106.78	4325	4620	7390
16.79	106.45	4295	4570	7630
14.13	108.85	4505	4900	6950
16.09	106.73	4242	4735	7620
13.93	109.35	4385	4800	6690
18.99	105.70	3805	4020	7640
16.64	106.50	4318	4600	7660
17.48	106.19	4112	4370	7340
20.32	105.33	3655	3745	7610
10.43	119.50	3980	4760	5970
9.46	123.60	3725	4610	4360
12.99	111.55	4425	4935	6410
14.91	107.35	4445	4770	7110
12.96	111.64	4370	4880	6320

Calculated mixture ratios for maximum power and economy, using temperature measurements of Hershey and Paton, agree closely with experimental results

Calculations

The maximum pressure produced by exploding a combustible mixture *at constant volume* can be calculated by means of the simple gas law

$$P = kNT \quad \ldots\ldots\ldots\ldots (1)$$

in which P is the maximum pressure; k, a constant; N, the number of molecules of combustion products (including nitrogen and unused oxygen), and T, the maximum flame temperature. Since the values of T which will be used are those obtained experimentally by Hershey and Paton, it remains only to calculate the change in the number of molecules of combustion products with mixture ratio.

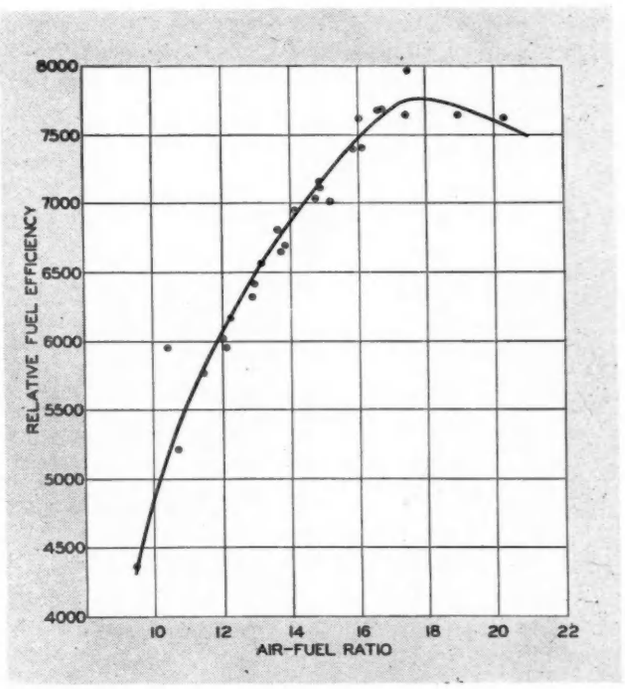


Fig. 2 — Graph showing the relative fuel efficiency

Since one gram atom of carbon produces one mol of CO_2 or one mol of CO, and two atoms of hydrogen produce one mol H_2O or one mol H_2, we have, when fuel is in excess, for the carbon gases

$$CO_2 + CO = \frac{pC}{12} \times (\text{wt. fuel}) \quad \ldots\ldots (2)$$

and for the hydrogen gases

$$H_2O + H_2 = \frac{pH}{2.016} \times (\text{wt. fuel}) \quad \ldots (3)$$

in which pC and pH are respectively the percentages of carbon and hydrogen in the fuel, while 12 and 2.016 are the atomic weights of one atom of carbon and two atoms of hydrogen.

Since the air-fuel ratio

$$R = \frac{\text{wt. air}}{\text{wt. fuel}}$$

we have for one mol of air

$$R = \frac{28.95}{\text{wt. fuel}} \quad \ldots\ldots\ldots\ldots (4)$$

Solving for weight fuel in (2) and (3) and substituting in (4), we finally obtain

$$R = \frac{2.412\ p}{CO_2 + CO} \quad \text{and} \quad R = \frac{14.46\ pH}{H_2O + H_2}$$

If the fuel contains 85 per cent carbon and 15 per cent hydrogen, the volume of carbon gases produced by combustion is

$$CO_2 + CO = \frac{205}{R} \ (\text{mols}) \quad \ldots\ldots (7)$$

and the volume of hydrogen gases produced by combustion is

$$H_2O + H_2 = \frac{216.4}{R} \ (\text{mols}) \quad \ldots\ldots (8)$$

If 100 mols of air are used, 79.1 mols of nitrogen will be present, so that the total volume of combustion products is 79.1 plus the sum of (7) and (8), or, if N is the mols of combustion products

$$N = 79.1 + \frac{421.4}{R} \ (\text{mols}) \quad \ldots\ldots (9)$$

for fuel in excess.

For mixtures containing an excess of air, we have from (7) and (8)

$$CO_2 = \frac{205}{R} \ (\text{mols}), \text{ and } H_2O = \frac{216.4}{R}$$

No change in volume occurs when CO_2 is formed, and the only increase in volume is that produced by the formation of water, the increase in volume being half the volume of water formed. Hence, for 100 mols of air, the total volume of combustion products is

$$N = 100 + \frac{108.2}{R} \ (\text{mols}) \quad \ldots\ldots (10)$$

All the numerical data are included in Table I, columns 1 and 3 being taken from Table III on page 37 of the paper of Hershey and Paton. Column 2 contains the mols of combustion products calculated by means of (9) and (10). Column 4 contains the figures for maximum explosion pressure which are obtained by substituting the values of T and N in equation (1), neglecting the values of k. The relative fuel efficiencies in column 5 are obtained by dividing the maximum explosion pressures in column 4 by the weight of fuel used in each case.

For a given set of initial conditions (volumetric efficiency, compression ratio, and speed), the power developed by the engine will be proportional to the explosion pressure, and we can say

$$\text{Relative Power} \propto P \propto NT \quad \ldots\ldots (11)$$

The values for relative pressure or relative power obtained by means of equation (11) are plotted in Fig. 1, and it can be seen that the "theoretical" mixture-ratio for maximum power is in close agreement with experimental observations.

The relative fuel efficiency* is obtained by dividing relative power by

* The term "fuel efficiency" is used here in place of the usual "indicated thermal efficiency". It is felt that the term "fuel efficiency" truly expresses the ratio (heat converted to work/potential heat in fuel used). Thermal efficiency, on the other hand, is the ratio (heat converted to work/heat liberated), and might be even greater for rich mixtures than for lean ones.

(*Continued from page 97*)

the immediate reflection of the utility of the process is in better surface finish and a reduction in power consumption of the hobber. We'll be glad to give you more if you are interested.

Welding Art

A round table discussion of practical shop men convinced us that we must look at welding in a much broader light than simply as a good production process. Welding holds all the elements of real service to the designer and production men and may be considered as the solution to many production problems, now classified as headaches.

Simplified Completely

Every now and then the technical man finds a publication that leaves its imprint in constructive advancement of technical process. A shining example in current literature is the book, "Tool Steel Simplified," by Frank R. Palmer, asst. to the president, The Carpenter Steel Co. As the title implies, it's a handbook designed to provide a clear understanding of modern tool steel materials and their most economical utilization in the production process. Its message, therefore, is as basic as the tool is basic in all metal cutting work. The 316 pages comprising the handbook are divided into five sections, of which Part 1—Getting acquainted with tool steel; Part 2—selecting the right tool steel; and Part 3—properties, heat treatment and testing—are concerned with the fundamentals of selection and handling. Part 4, aptly termed "Things Worth Knowing," deals with the more intimate "inside" information for the trained man. Part 5 is devoted to tabular data. Among other things, the book has a section dealing with a complete explanation of the Carpenter Matched Set Method with which automotive tool engineers are undoubtedly familiar to some extent. Although the book is concerned with Carpenter steels specifically, it covers the fundamentals of tool steel selection and utilization so masterfully and clearly as to throw a bright light on tool steels in general no matter what their source. We recommend this book to readers of our page. It has a price of $1 in the U. S. and we'll be glad to put you in touch with the publishers.

Smoke Control

As one well-known Diesel researcher puts it, the rated horsepower of an automotive Diesel engine is really a function of where it will produce a clear exhaust. That, however, is the moot point. What is smoke? How clear must be the exhaust to be declared smoke-free? These are questions for which there seems to be no quantitative measure at the moment. There is hope that a definite answer may be forthcoming in the not too distant future. Given a definition of smoke as well as a means for quantitative measurement, Diesel designers will be armed with the tools that can show the way to major improvement in combustion control. At least that's what we infer.—J. G.

Both Ends Broached at Once

BOTH ends of a finished rear axle housing assembly are broached in one set-up on a single machine at the Chevrolet Gear and Axle plant in Detroit. The arrangement is said to insure absolute parallelism between the broached surfaces, accurate locating, and a minimum of handling on the part of the operator.

The operation requires the removal of about ½ in. of metal from one side of both rear axle flanges to produce a flat ⅜ in. wide and 4 in. long for the mounting of the brake backing plates. The job is handled by the use of two standard Colonial single ram columns mounted on a single wide base.

Both rams have a 60 in. stroke with a rated capacity of 10 tons per ram. They are hydraulically interlocked for simultaneous cutting and return strokes. The loaded fixture shuttles into position automatically when the machine is started, the rams then travel down and at the end of the stroke the fixture shuttles back for unloading during the return stroke. The fixture has a setting to give four production runs for every sharpening of the broaches, the broaches being wider than required for a normal cut. In this arrangement the fixture shifts over to one side when shuttling into cutting position. At the present time some 20,000 axle ends have been broached without the first sharpening of the broaches.

Flanges on both ends of these Chevrolet axles are broached simultaneously on this set-up having a single base and two Colonial single ram vertical broaching machine columns.

Fuel Efficiency

(Continued from page 99)

the weight of fuel used. Since the weight of fuel used would be proportional to the reciprocal of the air-fuel ratio, we have

$$\text{Relative fuel efficiency} \propto \frac{\text{Relative power}}{1/R}$$

where R is the air-fuel ratio. That is

$$\text{Relative fuel efficiency} \propto \frac{NT}{1/R} \propto RNT \quad (12)$$

Fig. 2 shows a graph of the product of air-fuel ratio, mols of combustion products, and maximum explosion temperature, and represents the relative fuel efficiency.

It is interesting to note that the air-fuel ratio giving best fuel economy, or the minimum "specific" fuel consumption is about 17 to 1, which agrees with most of the experimental observations of this point.

Although the temperature measurements of Hershey and Paton were obtained with an engine of low compression ratio running at low speed, it is felt that the variation of maximum explosion temperature with mixture ratio is sufficiently independent of conditions of operation to warrant the conclusion that the above treatment of their data and the results obtained can be regarded as of general validity for the influence of mixture ratio on power and fuel economy.

New Radial Diesel

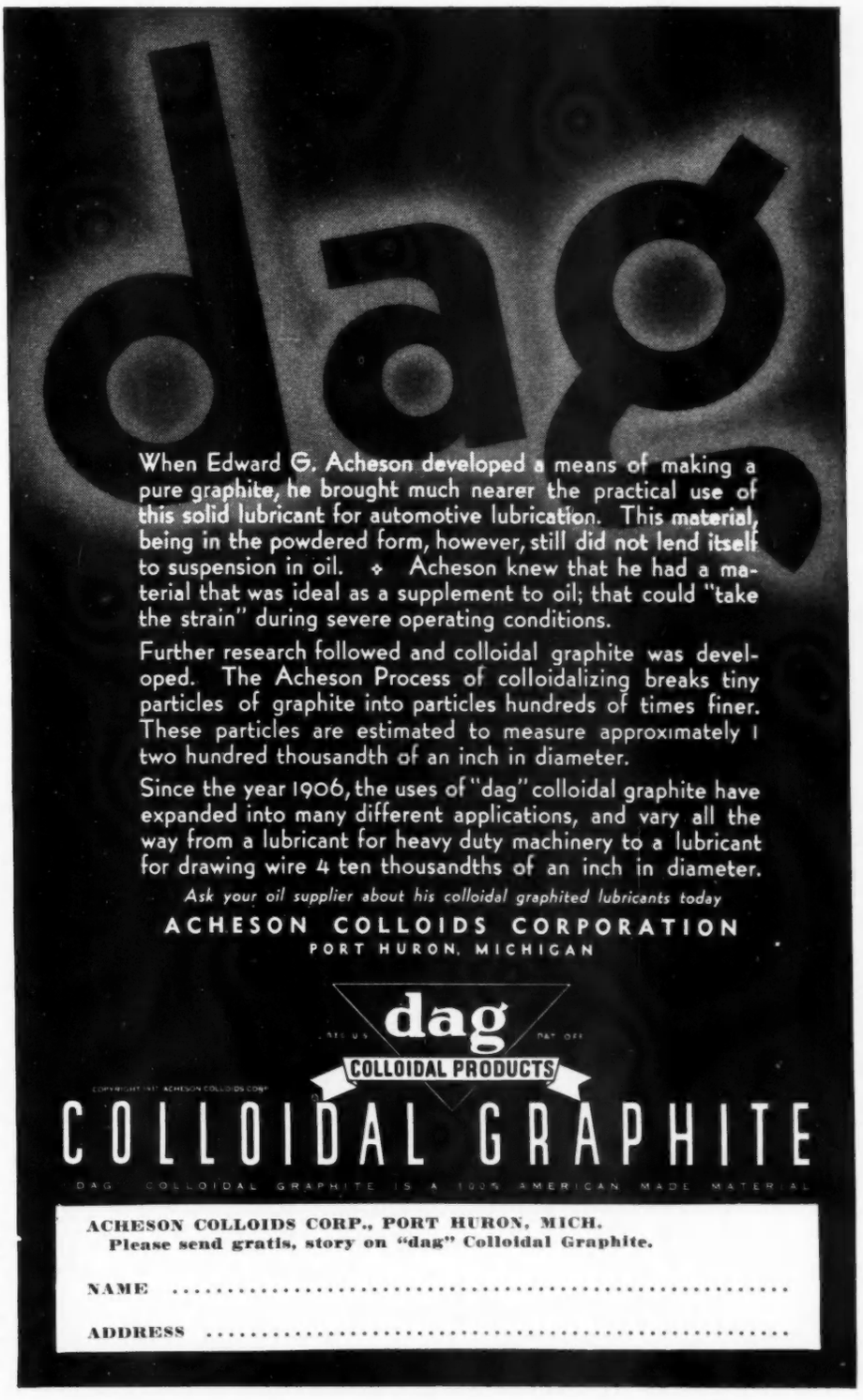
M. Clerget's Two-Row Engine Develops 450-500 Hp. at 1800 R.P.M.

M. CLERGET, a French engineer who has been working on Diesel aircraft engines for a number of years, has developed a fourteen-cylinder radial engine in the Government laboratories. The bore is 140 and the stroke 160 mm. (5.51 by 6.30 in.), the displacement 2104 cu. in., and the engine develops 450-500 hp. at 1800 r.p.m. It weighs 1320 lb. and the consumption is given as 0.396 lb. per hp-hr. In deciding on a fourteen-cylinder, two-row radial the object was to smooth out the torque curve as much as possible.

Recently the efforts of M. Clerget have been directed toward increasing the efficiency and flexibility, and reducing the peak pressures of the engine. Two different methods have been followed, both intended to reduce the ignition delay. One consists in the use of an auxiliary fuel of relatively low ignition temperature, while the other aims at reducing the maximum temperature (and therefore the maximum pressure) of combustion by the use of a fuel of relatively high heat of vaporization such as alcohol.

Cylinder heads and pistons of the new Clerget engine are of aluminum alloy, but all other parts, including the crankcase, are of steel. This is in contrast to the practice of the Junkers Works, who build their engines almost wholly of aluminum. The Junkers engine is also being built in France, in a slightly modified form, by the Compagnie Lilloise des Moteurs, and in an article on recent developments in aircraft Diesel engines by M. Martinot-Lagarde of the French Air Service, it is pointed out that the pistons of the CLM Junkers engine now are of composite construction, having a steel crown and an aluminum skirt.

In the new Clerget, liquid cooling is provided for on the cylinder barrels, while the cylinder heads are air-cooled. A small lot of the Clerget engines have been built and subjected to bench tests


dag
When Edward G. Acheson developed a means of making a pure graphite, he brought much nearer the practical use of this solid lubricant for automotive lubrication. This material, being in the powdered form, however, still did not lend itself to suspension in oil. Acheson knew that he had a material that was ideal as a supplement to oil; that could "take the strain" during severe operating conditions.
Further research followed and colloidal graphite was developed. The Acheson Process of colloidalizing breaks tiny particles of graphite into particles hundreds of times finer. These particles are estimated to measure approximately one two hundred thousandth of an inch in diameter.
Since the year 1906, the uses of "dag" colloidal graphite have expanded into many different applications, and vary all the way from a lubricant for heavy duty machinery to a lubricant for drawing wire 4 ten thousandths of an inch in diameter.
Ask your oil supplier about his colloidal graphited lubricants today
ACHESON COLLOIDS CORPORATION
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DAG COLLOIDAL GRAPHITE IS A 100% AMERICAN MADE MATERIAL
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Please send gratis, story on "dag" Colloidal Graphite.
NAME .....
ADDRESS .....

and flight tests, using a double injection of gas oil. A supercharger is being experimented with. Without supercharger the operation remains normal up to 16,000 ft. altitude, and by a slight increase in the amount of fuel injected the output can be kept constant up to an altitude of 9800 ft. Flight tests were made in a Potez plane between Paris and Tours and Paris and Bordeaux, accompanied by another plane of the same model but equipped with a Lorraine 450-hp. gasoline engine, and the Diesel showed a fuel economy of 30 per cent on the weight basis.

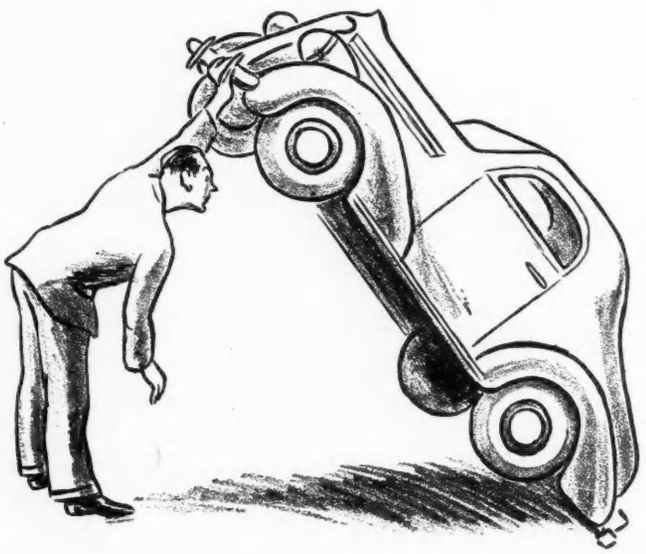
Materials News

(Continued from page 90)

larly where the work is nitrided, case hardened, or heat treated shafts. Besides longer life, other advantages accruing from tipping lathe and grinder centers with Carboloy are said to be greater accuracy, elimination of burning and scoring, and fewer reconditionings.

Have you a use for this

EXTRA STRONG DUREZ 1590?



Five times the impact-strength of ordinary plastic material—that's what you get in the new Durez 1590!

There must be places in your car, truck, bus or plane where this tougher molding material can be used to advantage. Places where ordinary materials lack strength. Mechanical parts where its light weight and wear resistance are valuable. Structural parts where you need its insulating value, or chemical resistance.

Durez 1590 has all the properties of regular phenolic plastics, except for a slightly rippled, wavy surface, which can be minimized by ribbing or engraving on decorative parts. It's furnished in black and natural.

Check over chassis and body for parts that can be made better or less expensive with this new molding compound. We'll gladly send you or your molder more complete information, samples, etc. Write General Plastics, Inc., 27 Walck Road, North Tonawanda, N. Y.

General Plastics'

DUREZ *Choice of the Automotive Industry*

Holland Produces a New Synthetic Rubber

A new synthetic rubber has been produced in the laboratories of the N. V. Voorheen Gebroeders Merens in Harlem, Holland, which is said to be one of the oldest rubber-goods factories in the Netherlands.

The new synthetic product is said to show great resistance to abrasion and to be unaffected by gasoline and other petroleum distillates. It is also resistant to heat and light, as well as to the aging effects of air. Acids, alkalies and corrosive gases have no effect on it.

The new product, which has been named "meprene", is intended for use in diaphragms of pumps and for the cylinders of rotary presses.

Alloy for Heavy Duty Pistons and Airplane Engine Cylinder Heads

As the result of much experimentation, the Ray Day Piston Corp., Detroit, has developed an alloy for which it claims excellent results in Diesel and heavy duty pistons, airplane cylinder heads, and similar parts where high strength is needed, and where strength and hardness are maintained at elevated temperatures. Nominal percentage composition of this alloy, in addition to pure aluminum, is as follows: copper, 3.5; nickel, 1.35; silicon, 1.25; magnesium, 1.10.

In fully heat treated condition, chilled cast test bars are reported to show a tensile strength of 53,000 to 56,000 lb. per sq. in., a Brinell hardness of 138, and elongation of 1 per cent.

According to the manufacturer, the characteristics of the alloy make it especially desirable for aircraft cylinder heads because it is unnecessary to use high pouring temperatures to run thin cooling fins, and produces sound, non-porous castings. It is excellent for Diesel pistons due to its high strength and toughness, and because a Brinell hardness of 138 is obtained with full heat treatment.

The chemical analysis is closely held as is the pouring temperature of the metal. Heat treating is done in electric furnaces with closely controlled temperatures.

Reo's Loss Greater

The Reo Motor Car Co. reports a loss for the March quarter of $269,495 compared with a loss for the same period last year of $195,366.